About the Author

Martin James Duggan, CCIE No. 7942, is a network architect for AT&T. He designs network solutions for customers globally and specializes in Campus LAN design and network reviews. Martin mentors colleagues through their Cisco qualifications and holds regular internal training classes. Previous to this Martin was a network architect for IBM, performing IP network designs and global network reviews. Martin has been in the industry for 18 years and has focused on Cisco solutions for the last 11 years. Martin is the co-author of the Cisco Press title Routing and Switching Practice Labs, Volume I.

About the Technical Reviewers

Maurilio de Paula Gorito, CCIE No. 3807, is a triple CCIE, having certified in Routing & Switching in 1998, WAN Switching in 2001, and Security in 2003. Maurilio has more than 18 years of experience in networking, including Cisco networks and IBM/SNA environments. Maurilio’s experience includes the planning, designing, implementation, and troubleshooting of large IP networks running RIP, IGRP, EIGRP, BGP, OSPF, QoS, and SNA worldwide, including Brazil and the USA. He also has more than 7 years of experience in teaching technical classes at schools and companies. Maurilio currently works for Cisco as part of the CCIE Team. As a content lead, Maurilio is responsible for managing the content development process for the CCIE Routing & Switching lab and written exams, for being in touch with candidates as part of the CCIE customer service, and for proctoring CCIE Routing & Switching and CCIE Security Lab exams at the CCIE Lab in San Jose, California, USA. Maurilio also has presented power sessions at Cisco seminars. He holds degrees in mathematics and pedagogy.

Leah Lynch, CCIE No. 7220 (Routing and Switching), is the product manager for routing protocols and MPLS technologies on the Spirent TestCenter platform at Spirent Communications. Leah has more than 12 years of experience in the IT industry, with 10 years focused on heterogeneous internetwork environments, including banking, retail, medical, government, manufacturing, corporate, sales, network service provider, telecommunications, and mobile wireless networks. Leah also holds several other Cisco Certifications and is currently working on her Service Provider CCIE.
Dedications
I would like to dedicate this publication to my family. Mum and Dad, thanks for looking after my house while I have been away in Spain. Don’t worry; we will be coming back! Adela, you are a fantastic mother to our wonderful children. They are so fortunate to have someone as caring, as thoughtful, and so willing to make sacrifices as you are to call mum. James, you are one cool dude; it’s about time England won Wimbledon, and I’ll be there cheering you on when you make it to Center Court. I’ll also be the guy miles behind you when you swap your skis for a snowboard! Anna, what can I say? We are all so proud you were chosen as a member of the Corte de Honor in Valencia 2008. Enjoy your year, and for us you will always be the Queen.

Blanca eres muy especial y tu familia Inglesa te quiere muchísimo, siento que este libro no sea muy interesante para ti pero tus padres Paco y Eva lo pueden utilizar para dormirte pronto—Un Beso, tío “Maen.”

Acknowledgments
This is my second opportunity to write for Cisco Press, so I would like to thank Brett Bartow for once again providing me with this enviable opportunity.

To Maurilio and Leah, who reviewed this publication, I would like to say thanks for the time and experience you have put into this. You have shaped my work, and I really value your contributions.

I’d like to thank my current manager, Dave Mack. I am very lucky to have you as a manager, Dave. You really helped me this year, for which I am extremely grateful. I would also like to thank my previous manager, Nick Cooke. Nick, thanks for having faith and supporting my career. You still have some credits to use up, so just call when you want to cash them in, just not so early next time, please.

To Phil Guerin, I’d like to say thanks for trying out some of these questions and bringing me back to reality when they needed fine-tuning.

To Amy Jones, who schedules the CCIE Assessor slots, you really earned your paycheck when I needed access to the site. Thanks very much and sorry for all the late notice requests; this wouldn’t have been possible without your help.
Icons Used in This Book

- Router
- Switch
- Multilayer Switch

Command Syntax Conventions

The conventions used to present command syntax in this book are the same conventions used in the IOS Command Reference. The Command Reference describes these conventions as follows:

- **Boldface** indicates commands and keywords that are entered literally as shown. In actual configuration examples and output (not general command syntax), boldface indicates commands that are manually input by the user (such as a show command).
- **Italics** indicate arguments for which you supply actual values.
- Vertical bars (|) separate alternative, mutually exclusive elements.
- Square brackets [ ] indicate optional elements.
- Braces { } indicate a required choice.
- Braces within brackets [ ] indicate a required choice within an optional element.
Introduction

For more than 10 years, the CCIE program has identified networking professionals with the highest level of expertise. Fewer than 3 percent of all Cisco certified professionals actually achieve CCIE status. The majority of candidates who take the exam fail at the first attempt because they are not fully prepared. They generally find that their study plan did not match what was expected of them in the exam. This practice exam has been designed to bring you as close as possible to actually taking the real lab exam. It can show you whether you are ready to schedule your lab or if you must reevaluate your study plan.

Exam Overview

The CCIE qualification consists of 2 exams, a 2-hour, written exam followed by an 8-hour, hands-on lab exam. Written exams are computer-based, multiple-choice exams lasting 2 hours and available at hundreds of authorized testing centers worldwide. The written exam is designed to test your theoretical knowledge to ensure that you are ready to take the lab exam. As such, you are eligible to schedule the lab exam only after you have passed the written exam. Because you have purchased this practice lab exam, it is assumed that you have passed the written exam and are ready to practice for the lab exam. The lab exam is an 8-hour, hands-on exam that requires you to configure a series of complex scenarios in strict accordance to the questions. It’s tough but achievable. Troubleshooting is an important skill, and candidates are expected to identify and solve issues as part of the CCIE lab exam. Current lab blueprint content information can be found at the following URL:

Scoring Point System
In the real exam, a higher number of points offered for certain questions generally indicates that the required solution takes more time to achieve or that multiple lines of configuration are involved. This practice lab closely echoes the scoring system in place in the real exam. If you find you are running short on time, try to get the smaller tasks completed and then return to the more complex questions.

Study Roadmap
Taking the lab exam is all about experience. You can’t expect to take it and pass after just completing your written exam and by relying on your theoretical knowledge. You must spend countless hours of rack time configuring features and learning how protocols interact with one another. To be confident enough to schedule your exam, make sure you follow the guidelines outlined next.

Assessing Strengths
Using the content blueprint, determine your experience and knowledge in the major topic areas. For areas of strength, practicing for speed should be your focus. For weak areas, you might need training or book study in addition to practice.

Study Materials
Choose lab materials that provide configuration examples and take a hands-on approach. Look for materials that are approved or provided by Cisco and its Learning Partners.
Hands-On Practice
Build and practice lab scenarios on a per topic basis. Go beyond the basics and practice additional features. Learn the show and debug commands along with each topic. If a protocol has multiple ways of configuring a feature, practice all of them.

Cisco Documentation CD
Make sure you can navigate the Cisco documentation CD with confidence because this is the only resource you are allowed during the lab. Make the CD part of your regular study; if you are familiar with it, you can save time during the exam. As of March 2006, the documentation can be navigated using only the index; the search function has been disabled.

Home Labs
Although acquiring a personal home lab is ideal, gathering all the equipment you need can be costly.

CCIE Assessor
You can access a practice lab on live Cisco equipment via a web interface, and it provides a personalized performance assessment. This practice exam was created using the CCIE Assessor version B topology and is available for online rental in 4-hour slots. If you do not have your own equipment, this is an excellent method of completing this practice lab. Load the initial configuration files supplied and run through the questions. Information on the Assessor can be found here:


If you plan to use the Assessor for this exercise, it is suggested you run through the lab instructions prior to beginning your online session to maximize your time on the site.
Equipment List and IOS Requirements

The lab exam tests any feature that can be configured on the equipment and the IOS versions indicated as follows:

- 3725 series routers - Cisco IOS Software Release 12.4 mainline: Advanced Enterprise Services
- 3825 series routers - Cisco IOS Software Release 12.4 mainline: Advanced Enterprise Services
- Catalyst 3550 series switches running Cisco IOS Software Release version 12.2: IP Services
- Catalyst 3560 series switches running Cisco IOS Software Release version 12.2: Advanced IP Services
Practice Lab

Aim to adhere to the time limit of 8 hours on this lab on the initial runthrough. Then either score yourself at this point or continue until you feel you have met all the objectives. You now are going to be guided through the equipment requirements and prelab tasks in preparation for taking this practice lab.

This lab was created using the official Cisco online CCIE R&S Assessor, version B topology. Detailed information on the Assessor can be found on the following URL:


If you don’t own six routers and four switches, the Assessor lab can be used for this lab by loading the initial files supplied for this chapter in Appendix A.

Equipment List

You need the following hardware and software components to commence this practice lab:

- Six routers loaded with Cisco IOS Software Release 12.4 Advanced Enterprise image and the minimum interface configuration as documented in Table 1-1.

<table>
<thead>
<tr>
<th>Router</th>
<th>Model</th>
<th>Ethernet I/F</th>
<th>Serial I/F</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>3825</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>R2</td>
<td>3725</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>R3</td>
<td>3825</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>R4</td>
<td>3825</td>
<td>2</td>
<td>—</td>
</tr>
<tr>
<td>R5</td>
<td>3825</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>R6</td>
<td>3825</td>
<td>2</td>
<td>—</td>
</tr>
</tbody>
</table>
NOTE
The CCIE Assessor version B online lab currently uses a mix of 3550 and 3560 switches. You can use all 3550s or all 3560s if you choose to, but be aware that you might have minor differences between platforms. The 3550 in this lab was loaded with c3550-ipservicesk9-mz.122-25.SEE.bin and the 3560s with c3560-ipservicesk9-mz.122-25.SEE.bin.

- One 3550 switch with Cisco IOS Software release 12.2 IP Services and three 3560 switches with Cisco IOS Software release 12.2 Advanced IP Services.

Setting Up the Lab
Feel free to use any combination of routers as long as you fulfill the requirements within the topology diagram as shown in Figure 1-1. However, it is recommended that you use the same model of routers because this makes life easier if you load configurations directly from those supplied into your own devices.

Access Configuration Appendixes Online
Log in at www.ciscopress.com/account to gain access to copy/paste enabled versions of the configuration files contained in the appendixes. A link to the content will be listed on your Account page under Registered Products.

Lab Topology
This practice lab uses the topology outlined in Figure 1-1, which you must re-create with your own equipment or by simply using the CCIE Assessor.
FIGURE 1-1
Lab Topology Diagram

NOTE
Notice in the initial configurations supplied that some interfaces do not have IP address preconfigured. This is because either you do not use that interface or you need to configure this interface from default within the exercise. The initial configurations supplied should be used to preconfigure your routers and switches before the lab starts.

If your routers have different interface speeds than those used within this book, adjust the bandwidth statements on the relevant interfaces to keep all interface speeds in line. This ensures that you do not get unwanted behavior because of differing Interior Gateway Protocol (IGP) metrics.
Switch Instructions

Configure virtual LAN (VLAN) assignments from the configurations supplied or from Table 1-2, with the exception of switch 2 Fa0/4 (this is configured during the lab).

Table 1-2 VLAN Assignment

<table>
<thead>
<tr>
<th>VLAN</th>
<th>Switch 1</th>
<th>Switch 2</th>
<th>Switch 3</th>
<th>Switch 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>Fa0/3, Fa0/4</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>45</td>
<td>Fa0/5</td>
<td>See questions</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>46</td>
<td>Fa0/6</td>
<td>See questions</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>100</td>
<td>—</td>
<td>Fa0/1</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>200</td>
<td>—</td>
<td>Fa0/2</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>300</td>
<td>I/F VLAN300</td>
<td>Fa0/5, Fa0/6,</td>
<td>I/F VLAN300</td>
<td>I/F VLAN300</td>
</tr>
</tbody>
</table>

Connect your switches with RJ-45 Ethernet crossover cables, as shown in Figure 1-2.

NOTE
The CCIE Assessor version B topology has been used for this lab. Additional interfaces available on the Assessor that are not required for this lab have been omitted from Figure 1-1.
If you are not using the CCIE Assessor, use Figure 1-1 and Figure 1-4 to determine how many interfaces you need to complete your own topology.

NOTE
Switch 2 is configured during the actual lab questions for VLAN45 and VLAN46 interface Fa0/4.
FIGURE 1-2
Switch-to-Switch Connectivity

Frame Relay Instructions
Configure one of your routers you are going to use in the lab as a Frame Relay switch, or have a dedicated router purely for this task. This lab uses a dedicated router within the CCIE Assessor version B topology for the Frame Relay switch. A fully meshed environment is configured between all the Frame Relay routers. Pay attention in the lab as to which permanent virtual circuits (PVC) are actually required. Keep the encapsulation and Local Management Interface (LMI) settings to default for this exercise, but experiment with the settings outside the labs to enhance your Frame Relay knowledge.
If you are using your own equipment, keep the data circuit-terminating equipment (DCE) cables at the frame switch end for simplicity and provide a clock rate to all links from this end.

After configuration, the Frame Relay connectivity represents the logical Frame Relay network, as shown in Figure 1-3.

**FIGURE 1-3**
Frame Relay Logical Connectivity

**IP Address Instructions**
In the real CCIE lab, you find that the majority of your IP addresses are preconfigured. For this exercise, you are required to configure your IP addresses as shown in Figure 1-4 or load the initial router configurations supplied in Appendix A. If you are manually configuring your equipment, be sure you include the following loopback addresses:

- R1 Lo0 120.100.1.1/24
- R2 Lo0 120.100.2.1/24
- R3 Lo0 120.100.3.1/24
- R4 Lo0 120.100.4.1/24
- R5 Lo0 120.100.5.1/24
R6 Lo0 120.100.6.1/24
SW1 Lo0 120.100.7.1/24
SW2 Lo0 120.100.8.1/24
SW3 Lo0 120.100.9.1/24
SW4 Lo0 120.100.10.1/24
Prelab Tasks

- Build the lab topology per Figure 1-1 and Figure 1-2.
- Configure your Frame Relay switch router to provide the necessary data-link connection identifiers (DLCI) per Figure 1-3.
- Configure the IP addresses on each router as shown in Figure 1-4 and add the loopback addresses. Alternatively, you can load the initial configuration files supplied in Appendix A if your router is compatible with those used to create this exercise. R1 requires a secondary IP address on its GigabitEthernet 0/1 interface for this lab. Details can be found on the accompanying initial configuration for R1 in Appendix A.

General Guidelines

- Please read the whole lab before you start.
- Do not configure any static/default routes unless otherwise specified.
- Use only the DLCIs provided in the appropriate figures.
- Ensure full IP visibility between routers for ping testing/Telnet access to your devices, with the exception of the switch loopback addresses. These are not visible to the majority of your network because of the configuration tasks.
- If you find yourself running out of time, choose questions that you are confident you can answer. Failing this, choose questions with a higher point rating to maximize your potential score.
- Get into a comfortable and quiet environment where you can focus for the next 8 hours.
- Take a 30-minute break midway through the exercise.
- Have a Cisco Documentation CD-ROM available, or access the latest documentation online from the following URL: www.cisco.com/univercd/home/home.htm

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Practice Lab 1

You will now be answering questions in relation to the network topology as shown in Figure 1-5.
Section 1: LAN Switching and Frame Relay (28 Points)

- Configure your switches as a collapsed backbone network with switches 1 and 2 performing core and distribution functionality and switches 3 and 4 as access switches in your topology. Switches 3 and 4 should connect only to the core switches. (2 points)

- Switches 1 and 2 should run spanning tree in 802.1w mode; switches 3 and 4 should operate in their default spanning-tree mode. (2 points)

- Configure switch 1 to be the root bridge and switch 2 to be the secondary root bridge for VLANs 1 and 300. (2 points)

- Ensure that you fully utilize the available bandwidth between switches by grouping your Inter-Switch Links (ISL) as trunks. Ensure that only dot1q and EtherChannel are supported. (3 points)

- Ensure that traffic is distributed on individual Ethernet trunks between switches based on the destination MAC address of individual flows. (2 points)

- Ensure that user interfaces are shut down dynamically by all switches if they toggle excessively. If they remain stable for 35 seconds, they should be re-enabled. (3 points)

- Fast Ethernet ports 0/11–17 will be used for future connectivity on each switch. Configure these ports as access ports for VLAN300, which should begin forwarding traffic immediately on connection. Devices connected to these ports will dynamically receive IP addresses from a DHCP server, which is due to be connected to port 0/18 on sw1 in the future. For security purposes, this is the only port on the network where DHCP addresses should be allocated from. Ensure that the switches intercept the DHCP requests and add the ingress port, VLAN, and switch MAC address prior to sending on to the DHCP server. Limit DHCP requests to 600 packets per minute per user port. (6 points)

- For additional security, ensure that the user ports on switches 1–4 (Fast Ethernet ports 0/11-17) can only communicate with the network with IP addresses gained from the DHCP feature configured previously. Use a dynamic feature to ensure that the only information forwarded upon connection is DHCP request packets and then any traffic that matches the DHCP IP information received from the DHCP binding for additional security. (3 points)
- R5 and R6 have been preconfigured with IP addresses on their Ethernet interfaces. Configure R4 and its associated switch port accordingly without using secondary addressing to communicate with R5 and R6. Configure R4 with an IP address of 120.100.45.4/24 to communicate with R5, and configure R4 with an IP address of 120.100.46.4/24 to communicate with R6. Configure R4 Gi0/1 and switch 2 FE0/4 only. (3 points)

- Your initial Frame Relay configuration has been supplied for the R1-R2-R3 connectivity and R2-R5. Configure each device per Figure 1-6 to ensure that each device is reachable over the Frame Relay network. Use only the indicated DLCIs. (2 points)
Section 2: IPv4 IGP Protocols (22 Points)

In this section, you will be answering questions about EIGRP, OSPF, and redistribution between these protocols.

Section 2.1: OSPF

- Configure OSPF per Figure 1-7. Use a process ID of 1. Where possible, all Open Shortest Path First (OSPF) configurations should not be configured under the process ID. Do not change the preconfigured interface types where applicable. Configure the loopback interfaces of routers R1, R2, and R3 to be in area 0, R4 in area 34, and R5 in area 5. (2 points)
No loopback networks should be advertised as host routes. (1 point)

Ensure that R1 does not advertise the preconfigured secondary address under interface Gigabit 0/1 of 120.100.100.1/24 to the OSPF network. Do not use any filtering techniques to achieve this. (2 points)

R5 should use the Frame Relay link within area 5 for its primary communication to the OSPF network. If this network should fail either at Layer 1 or Layer 2, R5 should form a neighbor relationship with R4 under area 5 to maintain connectivity. Your solution should be dynamic, ensuring that while the area 5 frame relay link is operational, no neighbor relationship exists between R4 and R5. However, the Ethernet interfaces of R4 and R5 must remain up. To confirm the operational status of the Frame Relay network, you should ensure that the serial interface of R5 is reachable by configuration of R5. You are permitted to define neighbor statements between R5 and R4. (4 points)

Section 2.2: EIGRP

Configure Enhanced Interior Gateway Routing Protocol (EIGRP) per Figure 1-8 using an AS number of 1. The loopback interfaces of all routers and switches should be advertised within EIGRP. (2 points)

Ensure that R4 does not install any of the EIGRP loopback routes from any of the switches into its routing table. As such, these routes should also not be present in the OSPF network post redistribution. Do not use any route-filtering access control lists (ACL), prefix lists, or admin distance manipulation to achieve this, and perform configuration only on R4. (3 points)

R4 will have dual equal-cost routes to VLAN300 (network 150.100.3.0) from R5 and R6. Ensure that R4 sends traffic to this destination network to R5 rather than load sharing. Should the route from R5 become unavailable, traffic should be sent to R6. Do not policy route, alter the bandwidth or delay statements on R4’s interfaces, or use an offset list. Perform your configuration on R4 only. Your solution should be applied to all routes received from R5 and R6 as opposed to solely to the route to network VLAN300. (3 points)
Section 2.3: Redistribution

- Perform mutual redistribution of IGP protocols on R4. All routes should be accessible with the exception of the switch loopback networks because these should not be visible via R4 as noted in an earlier question. EIGRP routes redistributed within the OSPF network should remain with a fixed cost of 5000 throughout the network. (3 points)

- Configure R4 to redistribute up to only five EIGRP routes and to generate a system warning when the fourth route is redistributed. Do not use any access lists in your solution. (2 points)
Section 3: BGP (14 Points)

- Configure Internal Border Gateway Protocol (iBGP) peering as follows: R1-R3, R2-R3, R6-R5, Sw1-R6, Sw1-R5. Use minimal configuration and use loopback interfaces for your peering. Configure External Border Gateway Protocol (eBGP) peering as follows: R3-R4, R4-R6, R4-R5, R5-R2. Use minimal configuration and use loopback interfaces for your peering with the exception of R4 to R5. Use the AS numbers supplied in Figure 1-9. (2 points)

- AS200 is to be used as a backup transit network for traffic between AS100 and AS300. As such, if the Frame Relay network between R5 and R2 fails, ensure that the peering between R2 and R5 is not maintained via the Ethernet network. Do not use any ACL-type restrictions or change the existing peering. (2 points)
CHAPTER 1

Practice Lab

- Configure a new loopback interface 2 on R2 of 130.100.200.1/24 and advertise this into Border Gateway Protocol (BGP) using the network command. Configure R2 in such a way that if the Frame Relay connection between R2 and R5 fails, AS300 no longer receives this route. Do not use any filtering between neighbors or neighbor-specific commands to achieve this. (3 points)

- Configure Hot Standby Router Protocol (HSRP) between R5 and R6 on VLAN300 with R5 the active for 1/24. If the network 130.100.200.0/24 is no longer visible to AS300, R6 should dynamically become the HSRP active. Configure R5 to achieve this solution. (4 points)

- Configure two new loopback interfaces on R1 and R2 of 126.1.1.1/24 and 130.1.1.1/24, respectively, and advertise these into BGP using the network command. R3 should be configured to allow only BGP routes originated from R1 up to network 128.0.0.0 and from above network 128.0.0.0 only those originated from R2. Use only a single ACL on R3 as part of your solution. (3 points)

Section 4: IPv6 (14 Points)

- Configure IPv6 addresses on your network as follows:
  2007:C15:C0:10::/64—R1 Gi0/0
  2007:C15:C0:11::/64—R1 S0/0/0
  2007:C15:C0:11::/2/64—R2 S0/0
  2007:C15:C0:11::/3/64—R3 S0/0/0
  2007:C15:C0:12::/2/64—R2 FE0/1
  2007:C15:C0:14::/2/64—R2 S0/1
  2007:C15:C0:14::/5/64—R5 S0/0/1
  2007:C15:C0:15::/3/64—R3 Gi0/0

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Section 4.1: RIPng

- Configure Routing Information Protocol next generation (RIPng), ensuring that your IPv6 routes are visible throughout your RIPng domain. Do not disable split-horizon. (3 points)
Section 4.2: OSPFv3

- Configure OSPFv3 with a process ID of 1 and with all OSPF interfaces assigned to area 0. (2 points)
- The IPv6 network is deemed to be stable. As such, reduce the number of link-state advertisements (LSA) flooded within the OSPF domain. (2 points)

Section 4.3: Redistribution

- Redistribute RIPng routes into the OSPFv3 domain (one way). RIP routes should have a fixed cost of 5000 associated to them within the OSPF network. (1 point)
- Ensure that the OSPFv3 network is reachable from the RIP network by a single route of 2007::/16, which should be seen within the RIP domain. Configure R5 only to achieve this. The OSPF domain should continue to receive specific RIPng subnets. (2 points)
- If the serial link fails between the OSPF and RIPng domains, ensure that routing is still possible between R5 and R4 over VLAN45. Do not enable RIP on the VLAN45 interfaces of R4 and R5. Configure R4 and R5 to achieve this, and this should be considered an alternative path only in the event of a failure. (3 points)
- Ensure that the summary route configured previously is not seen back on the routing table of R5. Configure only R5 to achieve this. (1 point)
Section 5: QoS (8 Points)

- You are required to configure quality of service (QoS) on switch 1 according to the Cisco QoS baseline model. Create a Modular QoS configuration that facilitates the following requirements for all user ports (Fast Ethernet 1–24) (3 points):

  1. All ports should trust the Differentiated Services Code Point (DSCP) values received from their connecting devices.

  2. Packets received from the user ports with DSCP values of 10, 16, 24, 28, 32, 34, 46, and 48 should be remarked to DSCP 8 Per Hop Behavior (PHB CS1) in the event of traffic flowing above 5 Mbps on a per port basis. This traffic could be a combination of any of the earlier DSCP values with any source/destination combination. Ensure that a minimum burst value is configured above the 5 Mbps.

- Switch 1 will be connected to a new trusted domain in the future using interface Gigabit 0/1. A DSCP value of AF43 received locally on sw1 should be mapped to AF42 when destined for the new domain. (2 points)
Configure Cisco Modular QoS into classes as follows on R1 for the following traffic types based on their associated PHB. Incorporate these into an overall policy that should be applied to the T1 interface S0/0/0. Assume a permanent virtual circuit (PVC) of line rate on the Frame Relay network and allow each class the effective bandwidth as detailed (3 points):

<table>
<thead>
<tr>
<th>Class</th>
<th>PHB</th>
<th>Assigned Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routing</td>
<td>CS6</td>
<td>46 kbps</td>
</tr>
<tr>
<td>VoIP</td>
<td>EF</td>
<td>247 kbps</td>
</tr>
<tr>
<td>Interactive Video</td>
<td>AF41</td>
<td>247 kbps</td>
</tr>
<tr>
<td>Mission Critical Data</td>
<td>AF31</td>
<td>247 kbps</td>
</tr>
<tr>
<td>Call-Signaling</td>
<td>CS3</td>
<td>46 kbps</td>
</tr>
<tr>
<td>Transactional Data</td>
<td>AF21</td>
<td>216 kbps</td>
</tr>
<tr>
<td>Network-mgmt</td>
<td>CS2</td>
<td>46 kbps</td>
</tr>
<tr>
<td>Bulk Data</td>
<td>AF11</td>
<td>46 kbps</td>
</tr>
<tr>
<td>Scavenger</td>
<td>CS1</td>
<td>15 kbps</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
<td>386 kbps</td>
</tr>
</tbody>
</table>
Section 6: Security (8 Points)

- Configure R3 to identify and discard the following custom virus. The virus is characterized by the ASCII characters “Hastings_Beer” within the payload and utilizes User Datagram Protocol (UDP) ports 11664 to 11666. The ID of the virus begins on the third character of the payload. The virus originated on VLAN34. (3 points)

- An infected host is on VLAN200 of 150.100.2.100. Ensure that only within BGP AS10, traffic destined for this host is directed to Null0 of each local router. You cannot use any ACLs to block traffic to this host specifically, but you can use a static route pointing to Null0 for traffic destined to 192.0.2.0/24 on routers within AS10. R2 can have an additional static route pointing to Null0. Use a BGP feature on R2 to ensure that traffic to this source is blocked. Prevent unnecessary replies when traffic is passed to the Null0 interface for users residing on VLAN100. (3 points)

Section 7: Multicast (6 Points)

- Configure routers R1, R2, R3, and R4 for IPv4 Multicast. Configure R3 to send multicast advertisements of its own time by use of Network Time Protocol (NTP) sourced from interface Gig 0/0. Configure Protocol Independent Multicast (PIM) spare mode on all required interfaces. R3 should also be used to advertise its own Gigabit interface IP address as a rendezvous point (RP). R3 should also advertise the IP address you are using for the NTP advertisements, which is to be 224.0.1.1. Do not use the command ntp server in any configurations. Routers R1, R2, and R4 should all show a clock synchronized to that of R3. (5 points)
“Ask the Proctor”

Section 1: LAN Switching and Frame Relay

Q: Do you want me to configure the collapsed backbone network by manipulating spanning tree to ensure that switch 1 and switch 2 are the cores for each VLAN in use?

A: You are requested to configure root bridges in a later question.

Q: All the switches are already connected, so I can’t change this unless I shut down some of the connections between switches. Is this acceptable?

A: Yes.

Q: Would you like me to VLAN load balance to utilize bandwidth?

A: No, the question directs you how to use the trunks.

Q: Would you like me configure switch 1 to allocate DHCP addresses?

A: No, the question relates to a fictitious DHCP server that would be connected to Fa0/18 on switch 1.

Q: Can I manipulate a helper-address function to answer the DHCP question by using ACLs?

A: No, use a recognized DHCP security-related solution.

Q: Can I configure port security to bind my MAC addresses?

A: No, use a feature that compliments your DHCP solution.

Q: Can I just configure R4 to trunk to switch 2 and have a subinterface in both VLAN45 and VLAN46?

A: Yes.
Q: I’ve configured my trunk on switch 2 to R4, and I can’t ping between R4 and R5. Similarly, I can’t ping between R4 and R6. Is there anything else I need to do?
A: Remember, the switches are in VLAN Trunking Protocol (VTP) Transparent mode. You might want to check that switch 2 has the required VLANs configured to enable propagation within your switched network.
Q: My Frame Relay network picks up the DLCIs automatically. Is this okay?
A: No, you need to ensure that you do not use additional DLCIs other than those specified.
Q: So, do you want me to manually map to the DLCIs I should be using?
A: Yes.

Section 2: Ipv4 IGP Protocols
In this section, you will be answering questions about EIGRP, OSPF, and redistribution between these protocols.

Section 2.1: OSPF
Q: I am used to configuring OSPF under the process. Surely this is the only place I can configure the parameters?
A: Recent advances in OSPF allow you to configure it purely under specific areas of the router, rather like with IPv6. Take a look at the commands available to you under the interfaces.
Q: My neighbor relationship is down over the Frame Relay network. I notice I have different OSPF network types preconfigured. Can I change these?
A: No, use an alternative method of bringing the interface parameters back into line.
Q: My secondary address is advertised automatically under OSPF. Can I use a distribute list or prefix-type list to block it?
A: No, use an OSPF feature to disable the advertisement of this secondary address.
Q: I’ve attempted to form a neighbor relationship with R4 from R5 using a backup interface. Is this okay?

A: No, the question states that your solution should cater for either Layer 1 or Layer 2 failures and that the Ethernet should remain up. Backup interfaces would be fine for a Layer 1 failure, but not for a Layer 2 type issue. If you have problems with specific DLCIs that cause neighbor failures over the Frame Relay, this feature also ensures that the Ethernet network is down until the backup interface is activated.

Q: How about having an OSPF demand circuit between R4 and R5?

A: No, this would involve a neighbor relationship being maintained. You need to allow the neighbor relationship to be formed only in the event of a failure condition.

Q: Can I use BFD between R4 and R5?

A: No, this might aid in failure detection, but it does not meet the objectives of the question.

Q: To confirm the operation status of R5’s serial interface, can I just ping it?

A: You can use Internet Control Message Protocol (ICMP), but you need to ensure that your solution is dynamic.

Q: My Frame Relay is up on R5, and I can ping across it to R2 from R5. But I can’t ping my own Frame Relay interface. Is this normal?

A: Yes, perform a debug of the Frame Relay packets if you need to. Remember what you need to gain IP connectivity on a Frame Relay network.

Q: If I use IP service-level agreement (SLA) to automatically ping R5 to check the status then, is this okay?

A: Yes.

Q: Okay, I have IP SLA running, but I’m stuck. Is this anything to do with tracking the response to the ping?

A: Yes.

Q: How about if I use policy routing with the next hop based on the tracking status?

A: This is fine. Just remember that this traffic is based locally on the router when applying any policies.
Q: I’ve worked out how to do this and managed to get a neighbor up when the Frame Relay fails, but my OSPF connectivity is still not perfect through the Ethernet. Is this normal?

A: Not if you have configured correctly. Take a look at your topology and areas; something might have changed when R5 connects over the Ethernet.

**Section 2.2: EIGRP**

Q: If I advertise my loopbacks into EIGRP, won’t that mean that R4 and R5 have their loopbacks advertised by both OSPF and EIGRP?

A: Yes, this is fine and is in accordance with the question.

Q: To stop R4 from receiving the switch loopbacks, can I stop advertising them from the switches?

A: No, you should use a feature on R4 to block them.

Q: Can I use a neighbor prefix list to block the loopbacks?

A: No, you cannot use any type of ACLs or prefix lists.

Q: I’ve noticed when I look at the specific loopback routes that they have a hop count associated with them. It’s unusual to associate hop counts with EIGRP, but can I block routes based on their hop count?

A: Yes.

Q: If I can’t change the bandwidth and delay on R4, can I use a route map to manipulate the “EIGRP K” values associated on a per neighbor basis?

A: Yes.
Section 2.3: Redistribution

Q: Do you require a distribute list to block the switch loopbacks from entering the OSPF domain?

A: No, you should have blocked these from entering your IP routing table within R4 previously, so additional blocking should not be required.

Q: I have only one redistribution point. As such, I reap no benefit in creating filtering to protect against potential routing loops between protocols. Is this acceptable?

A: Yes, in this scenario filtering would be superfluous.

Q: Can I use a route map to allow five specific EIGRP routes to be redistributed into OSPF?

A: No, the question doesn’t guide you to redistribute specific routes; use a more general method of allowing a specific number of routes.

Section 3: BGP

Q: Is it okay to disable autosynchronization in BGP?

A: You must determine whether you need this feature on or off. Remember that you should have synchronization on only when you are fully redistributing between BGP and your IGP.

Q: I find that when the Frame Relay network fails, my neighbor relationship is still maintained between R2 and R5. This is because the loopback routes are still available over the alternative path through the network. Can I block my loopbacks or policy route at some point to effectively break the peering?

A: You need to effectively break the peering, but you can use a far simpler method to achieving this, one that still maintains unaltered communication between R2 and R5. Think about what you need to configure when you have eBGP peers.

Q: I might have been a little generous with my original multi-hop value between R2 and R5. I can break the peering if I reduce this down to a Time To Live (TTL) of 2. Is this okay?

A: Yes.
Q: I think I can stop the loopback on R2 being advertised by using the community value of no-export, but if I enable this to R2, wouldn’t it make it to R5 even when the Frame Relay is working?
A: It wouldn’t be advertised to R5 AS300 from R2. You just have to think about whether R2 is the best place to send the community to originally.
Q: For the HSRP question, is this some form of conditional advertising?
A: No, the clue is in the question; just find a way of tracking the BGP route and manipulate the HSRP process.
Q: So if I enable IP SLA to track a route in the routing table, I can use this to control HSRP?
A: Yes.
Q: You haven’t told me what address I should use for HSRP. Is it okay to use the first address in the subnet?
A: Yes.
Q: I have configured my two new loopbacks. Can I use two route maps inbound from R1 and R2 both pointing to different ACLs so that each route map only calls one ACL?
A: No, you still have two ACLs.
Q: Can I set community values on the routes and match on these using a single ACL?
A: No, you are instructed to use an ACL; your solution would require additional configuration.
Q: Can I use a prefix list to achieve this?
A: No, you are instructed to use an ACL.
Q: So, I need an ACL with a mask that is suitable for both ranges?
A: Not necessarily. You only need to match one requirement on the permit functionality; the other could be met by deny.
Section 4: IPv6

Q: Should I use the eui-64 address format when configuring my addresses?
A: No, if these were required, you would have been instructed to do so in the question.

Q: I’ve configured my IPv6 addresses and created a Frame Relay map for these on my existing DLCIs, but I still can’t ping across the Frame Relay network. Should I be able to?
A: Yes, if you debug your Frame Relay traffic, you find you need additional configuration.

Q: I have configured RIPng between R1, R2, and R3. R3 receives both spoke routes, but R1 does not see the R2 IPv6 route and vice versa. If this is split-horizon behavior and I can’t disable it, can I create subinterfaces on my Frame Relay network?
A: No, use a feature that is common when running IPv6 over IPv4 networks.

Q: So, can I tunnel between R1 and R2?
A: Yes.

Q: You are not requesting mutual redistribution between RIPng and OSPFv3. How can my RIPng domain communicate with the OSPFv3 domain?
A: This issue is addressed in the following task.

Q: If I can’t use RIPng directly on VLAN45 between R4 and R5, can I configure OSPFv3 on VLAN45?
A: No, find a way to still run RIPng between routers without enabling it on the physical interfaces.

Q: So, can I tunnel between R4 and R5?
A: Yes.
Section 4.3: Redistribution

Q: I have redistributed RIPng into OSPFv3 on R5, which is the only suitable location, and noticed that I have noticed in my OSPFv3 domain I do not see the IPv6 network configured on the Frame Relay network between R2 and R5. Is this okay?

A: No, this network should be advertised to the OSPFv3 domain. Use a feature within the OSPFv3 process as you would to overcome this if this were IPv4 redistribution.

Q: Can I redistribute a static IPv6 route on R5 into RIPng for 2007::/16?

A: No static routes are permitted unless specified. What would you do if this were IPv4?

Q: If I can’t enable RIPng on VLAN45 between R4 and R5, can I enable OSPFv3?

A: No, this would also require you to perform redistribution at this point.

Q: How about tunneling again and enabling RIPng over the tunnel, is this okay?

A: Yes.

Q: I have created my tunnel and found that this is now the primary route rather than an alternative path. Can I perform some kind of backup interface to make this come up only in the event of a failure on the Frame Relay?

A: No, you haven’t been given sufficient information to make this judgment. This approach would also break your IPv4 network. Think why the Ethernet path is preferred and manipulate it.

Q: Can I use a prefix list to block the summary and permit all other IPv6 routes?

A: Yes, this is fine.
Section 5: QoS

Q: Can I just trust DSCP on my physical ports?
A: No, this should be completed as part of your policy.

Q: Shall I rate-limit my ports to 5M on a per port basis?
A: No, this should be completed as part of your policy.

Q: You haven’t indicated what the minimum burst size should be. Is this correct?
A: Yes, just use the available limits within the command options.

Q: I believe I can use a DSCP mutation map to convert the DSCP values for the future, but the command won’t take the values AF43 and AF42?
A: No, it won’t because these are Assured Forwarding values. You need to convert these to DSCP values. Search your Documentation CD or available Cisco.com pages.

Q: I am trying to assign bandwidth within my class with the speeds supplied, but I can see only a percentage option. Is this correct?
A: Yes, you’ll need to do some math. You are supplied with the information you require and just need to remember how fast a T1 line is.

Section 6: Security

Q: Can I use a route map and ACLs to identify the traffic by port number?
A: No, this would identify the Unidirectional Link Detection (UDLD) traffic but not the virus payload as per the question. Investigate the options open to you with Network-Based Application Recognition (NBAR).
Q: Can I policy route traffic destined to the infected host to Null0?
A: No, you need to use a BGP-related feature.

Q: A static route for 192.0.2.0/24 won’t have any bearing on traffic destined to the infected host. Why is this relevant?
A: Think about the way BGP works. It’s the only routing protocol where you don’t need to be directly connected to form a neighbor relationship. As such, you transport next-hop information with your updates.

Section 7: Multicast

Q: If I can’t configure ntp server on R1, R2, and R4, I have no way to get these routers to peer with R3. Is this correct?
A: Yes, you don’t need to specifically peer with R3 as the server. You should aim to receive the NTP stream that R3 is configured to multicast.

Q: Do you want me to create and announce the group 224.0.1.1 on R3?
A: Yes.
Lab Debrief

The lab debrief section now analyzes each question, showing you what was required and how to achieve the desired results. You should use this section to produce an overall score for this practice lab.

Section 1: LAN Switching and Frame Relay (28 Points)

Configure your switches as a collapsed backbone network with switches 1 and 2 performing core and distribution functionality and switches 3 and 4 as access switches in your topology. Switches 3 and 4 should connect only to the core switches. (2 points)

This is a simple start to the exercise. The switches are fully meshed to begin with. To create a collapsed backbone topology the core switches should be connected together, and each access switch should be dual homed to the core switches. The only switches that should not connect directly to each other are the access switches (Sw3 and Sw4). By shutting down the interfaces between Sw3 and Sw4, you create the required topology. If you have configured this correctly, as shown in Example 1-1, you have scored 2 points. Even though the resulting topology is not looped at this stage you can verify route bridge assignment by using the `show spanning tree root` command.

Example 1-1  Sw3 and Sw4 Configuration

```
SW3(config)# interface range fastEthernet 0/23-24
SW3(config-if-range)# shut

SW4(config)# interface range fastEthernet 0/23-24
SW4(config-if-range)# shut
```
Switches 1 and 2 should run spanning tree in 802.1w mode; switches 3 and 4 should operate in their default spanning-tree mode. (2 points)

802.1w is rapid spanning tree. This is backward compatible with the switches’ default (PVST), so by configuring switches 1 and 2 into rapid spanning-tree mode, spanning tree still operates effectively with switches 3 and 4. If you have configured this correctly, as shown in Example 1-2, you have earned another 2 points.

Example 1-2 Sw1 and Sw2 Configuration

```
SW1(config)# spanning-tree mode rapid-pvst
SW2(config)# spanning-tree mode rapid-pvst
```

Configure switch 1 to be the root bridge and switch 2 to be the secondary root bridge for VLANs 1 and 300. (2 points)

A straightforward question for the core switches. If you have configured this correctly, as shown in Example 1-3, you have 2 points.

Example 1-3 Sw1 and Sw2 Root Bridge Configuration

```
SW1(config)# spanning-tree vlan 1 root primary
SW1(config)# spanning-tree vlan 300 root primary

SW2(config)# spanning-tree vlan 1 root secondary
SW2(config)# spanning-tree vlan 300 root secondary
```

Make sure that you fully utilize the available bandwidth between switches by grouping your Inter-Switch Links (ISL) as trunks. Ensure that only dot1q and EtherChannel are supported. (3 points)
Another straightforward question for all switches to create EtherChannels between devices. Using the command `channel-group n mode on` under the physical interfaces ensures that only EtherChannel is supported, as opposed to Port Aggregation Protocol (PAGP) or Link Aggregation Control Protocol (LACP), and dot1q is the trunking protocol. For Layer 2 EtherChannels, you don’t have to create a port-channel interface first by using the `interface port-channel` configuration command before assigning a physical port to a channel group. You can use the `channel-group interface` configuration command, which automatically creates the port-channel interface, although a manual port channel configuration has been shown here for clarity. If you have configured this correctly, as shown in Example 1-4, you have scored 3 points.

### Example 1-4  Switches 1, 2, 3, and 4 EtherChannel Configuration

```bash
SW1(config)# interface Port-channel1
SW1(config-if)# switchport trunk encapsulation dot1q
SW1(config-if)# switchport mode trunk
SW1(config-if)# interface Port-channel2
SW1(config-if)# switchport trunk encapsulation dot1q
SW1(config-if)# switchport mode trunk
SW1(config-if)# interface Port-channel3
SW1(config-if)# switchport trunk encapsulation dot1q
SW1(config-if)# switchport mode trunk
SW1(config-if)# interface range FastEthernet0/19-20
SW1(config-if)# channel-group 1 mode on
SW1(config-if)# interface range FastEthernet0/21-22
SW1(config-if)# channel-group 2 mode on
SW1(config-if)# interface range FastEthernet0/23-24
SW1(config-if)# channel-group 3 mode on

SW2(config)# interface Port-channel1
SW2(config-if)# switchport trunk encapsulation dot1q
SW2(config-if)# switchport mode trunk
SW2(config-if)# interface Port-channel2
SW2(config-if)# switchport trunk encapsulation dot1q
```
Example 1-4  Switches 1, 2, 3, and 4 EtherChannel Configuration  continued

SW2(config-if)# switchport mode trunk
SW2(config-if)# interface Port-channel3
SW2(config-if)# switchport trunk encapsulation dot1q
SW2(config-if)# switchport mode trunk
SW2(config-if)# interface range FastEthernet0/19-20
SW2(config-if)# channel-group 1 mode on
SW2(config-if)# interface range FastEthernet0/21-22
SW2(config-if)# channel-group 2 mode on
SW2(config-if)# interface range FastEthernet0/23-24
SW2(config-if)# channel-group 3 mode on

SW3(config)# interface Port-channel1
SW3(config-if)# switchport trunk encapsulation dot1q
SW3(config-if)# switchport mode trunk
SW3(config-if)# interface Port-channel2
SW3(config-if)# switchport trunk encapsulation dot1q
SW3(config-if)# switchport mode trunk
SW3(config-if)# interface range FastEthernet0/19-20
SW3(config-if)# channel-group 1 mode on
SW3(config-if)# interface range FastEthernet0/21-22
SW3(config-if)# channel-group 2 mode on

SW4(config)# interface Port-channel1
SW4(config-if)# switchport trunk encapsulation dot1q
SW4(config-if)# switchport mode trunk
SW4(config-if)# interface Port-channel2
SW4(config-if)# switchport trunk encapsulation dot1q
Example 1-4  Switches 1, 2, 3, and 4 EtherChannel Configuration  

SW4(config-if)# switchport mode trunk
SW4(config-if)# interface range FastEthernet0/19-20
SW4(config-if)# channel-group 1 mode on
SW4(config-if)# interface range FastEthernet0/21-22
SW4(config-if)# channel-group 2 mode on

SW4# show interfaces port-channel 1 status

<table>
<thead>
<tr>
<th>Port</th>
<th>Name</th>
<th>Status</th>
<th>Vlan</th>
<th>Duplex</th>
<th>Speed Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Po1</td>
<td></td>
<td>connected</td>
<td>trunk</td>
<td>a-full</td>
<td>a-100</td>
</tr>
</tbody>
</table>

SW4# show interfaces port-channel 2 status

<table>
<thead>
<tr>
<th>Port</th>
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<th>Status</th>
<th>Vlan</th>
<th>Duplex</th>
<th>Speed Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Po2</td>
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<td>connected</td>
<td>trunk</td>
<td>a-full</td>
<td>a-100</td>
</tr>
</tbody>
</table>

SW4# show interfaces port-channel 3 status

<table>
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<th>Status</th>
<th>Vlan</th>
<th>Duplex</th>
<th>Speed Type</th>
</tr>
</thead>
<tbody>
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<td>connected</td>
<td>trunk</td>
<td>a-full</td>
<td>a-100</td>
</tr>
</tbody>
</table>

SW4# show etherchannel summary
Number of channel-groups in use: 3
Number of aggregators: 3

Group  Port-channel  Protocol  Ports
Example 1-4  Switches 1, 2, 3, and 4 EtherChannel Configuration  
---+
 1  Po1(SU) - Fa0/19(P)  Fa0/20(P)
 2  Po2(SU) - Fa0/21(P)  Fa0/22(P)
 3  Po3(SU) - Fa0/23(P)  Fa0/24(P)

SW2# show interfaces port-channel 1 status

<table>
<thead>
<tr>
<th>Port</th>
<th>Name</th>
<th>Status</th>
<th>Vlan</th>
<th>Duplex</th>
<th>Speed</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Po1</td>
<td></td>
<td>connected</td>
<td>trunk</td>
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<td>a-100</td>
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</tr>
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</table>

SW2# show interfaces port-channel 2 status

<table>
<thead>
<tr>
<th>Port</th>
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<th>Status</th>
<th>Vlan</th>
<th>Duplex</th>
<th>Speed</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
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<td>trunk</td>
<td>a-full</td>
<td>a-100</td>
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</table>

SW2# show interfaces port-channel 3 status

<table>
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<th>Name</th>
<th>Status</th>
<th>Vlan</th>
<th>Duplex</th>
<th>Speed</th>
<th>Type</th>
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<td>connected</td>
<td>trunk</td>
<td>a-full</td>
<td>a-100</td>
<td></td>
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</tbody>
</table>

SW2# show etherchannel summary
Number of channel-groups in use: 3
Number of aggregators: 3

<table>
<thead>
<tr>
<th>Group</th>
<th>Port-channel</th>
<th>Protocol</th>
<th>Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Po1(SU)</td>
<td></td>
<td>Fa0/19(P) Fa0/20(P)</td>
</tr>
<tr>
<td>2</td>
<td>Po2(SU)</td>
<td></td>
<td>Fa0/21(P) Fa0/22(P)</td>
</tr>
<tr>
<td>3</td>
<td>Po3(SU)</td>
<td></td>
<td>Fa0/23(P) Fa0/24(P)</td>
</tr>
</tbody>
</table>
Example 1-4  Switches 1, 2, 3, and 4 EtherChannel Configuration  continued

SW3# show interface port-channel 1 status

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<th>Status</th>
<th>Vlan</th>
<th>Duplex</th>
<th>Speed</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Po1</td>
<td></td>
<td>connected</td>
<td></td>
<td>a-full</td>
<td>a-100</td>
<td></td>
</tr>
</tbody>
</table>

SW3# show interface port-channel 2 status

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<th>Port</th>
<th>Name</th>
<th>Status</th>
<th>Vlan</th>
<th>Duplex</th>
<th>Speed</th>
<th>Type</th>
</tr>
</thead>
<tbody>
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<td>Po2</td>
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<td>connected</td>
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<td>a-full</td>
<td>a-100</td>
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</tr>
</tbody>
</table>

SW3# show etherchannel summary
Number of channel-groups in use: 2
Number of aggregators:  2

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<th>Group</th>
<th>Port-channel</th>
<th>Protocol</th>
<th>Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Po1(SU)</td>
<td>-</td>
<td>Fa0/19(P) Fa0/20(P)</td>
</tr>
<tr>
<td>2</td>
<td>Po2(SU)</td>
<td>-</td>
<td>Fa0/21(P) Fa0/22(P)</td>
</tr>
</tbody>
</table>

SW4# show interface port-channel 1 status

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<th>Name</th>
<th>Status</th>
<th>Vlan</th>
<th>Duplex</th>
<th>Speed</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Po1</td>
<td></td>
<td>connected</td>
<td></td>
<td>a-full</td>
<td>a-100</td>
<td></td>
</tr>
</tbody>
</table>

SW4# show interface port-channel 2 status
Example 1-4  Switches 1, 2, 3, and 4 EtherChannel Configuration  

<table>
<thead>
<tr>
<th>Port</th>
<th>Name</th>
<th>Status</th>
<th>Vlan</th>
<th>Duplex</th>
<th>Speed</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Po2</td>
<td></td>
<td>connected</td>
<td>trunk</td>
<td>a-full</td>
<td>a-100</td>
<td></td>
</tr>
</tbody>
</table>

SN4# show etherchannel summary
Number of channel-groups in use: 2
Number of aggregators: 2

<table>
<thead>
<tr>
<th>Group</th>
<th>Port-channel</th>
<th>Protocol</th>
<th>Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Po1(SU)</td>
<td>-</td>
<td>Fa0/19(P) Fa0/20(P)</td>
</tr>
<tr>
<td>2</td>
<td>Po2(SU)</td>
<td>-</td>
<td>Fa0/21(P) Fa0/22(P)</td>
</tr>
</tbody>
</table>

- Ensure that traffic is distributed on individual Ethernet trunks between switches based on the destination MAC address of individual flows. (2 points)

A common problem with EtherChannels is traffic not being distributed equally among the physical interfaces. Configuring channel load balancing based on the destination MAC address of an individual flow is just one method available to distribute traffic. If you have configured this correctly, as shown in Example 1-5, you have scored 2 points.

Example 1-5  Switches 1, 2, 3, and 4 EtherChannel Load Balancing Configuration

SW1(config)# port-channel load-balance dst-mac

SW2(config)# port-channel load-balance dst-mac

SW3(config)# port-channel load-balance dst-mac

SW4(config)# port-channel load-balance dst-mac

SW1# show etherchannel load-balance

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Example 1-5  Switches 1, 2, 3, and 4 EtherChannel Load Balancing Configuration  continued

<table>
<thead>
<tr>
<th>EtherChannel Load-Balancing Operational State (dst-mac):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-IP: Destination MAC address</td>
</tr>
<tr>
<td>IPv4: Destination MAC address</td>
</tr>
<tr>
<td>IPv6: Destination IP address</td>
</tr>
</tbody>
</table>

- Ensure that user interfaces are shut down dynamically by all switches if they toggle excessively. If they remain stable for 35 seconds, they should be re-enabled. (3 points)

Interfaces that flap can cause problems in a network. Toggling would usually indicate a problem such as a faulty connecting network interface card (NIC) or faulty cable. Placing the ports into error disable is a method of stabilizing the environment. If you have configured this correctly, as shown in Example 1-6, you have scored 3 points.

Example 1-6  Switches 1, 2, 3, and 4 Configuration

```
SW1(config)# errdisable recovery cause link-flap
SW1(config)# errdisable recovery interval 35

SW2(config)# errdisable recovery cause link-flap
SW2(config)# errdisable recovery interval 35

SW3(config)# errdisable recovery cause link-flap
SW3(config)# errdisable recovery interval 35

SW4(config)# errdisable recovery cause link-flap
SW4(config)# errdisable recovery interval 35
```
Fast Ethernet ports 0/11–17 will be used for future connectivity on each switch. Configure these ports as access ports for VLAN300, which should begin forwarding traffic immediately on connection. Devices connected to these ports will dynamically receive IP addresses from a DHCP server which is due to be connected to port 0/18 on sw1 in the future. For security purposes, this is the only port on the network from which DHCP addresses should be allocated. Ensure that the switches intercept the DHCP requests and add the ingress port, VLAN, and switch MAC addresses prior to sending on to the DHCP server. Limit DHCP requests to 600 packets per minute per user port. (6 points)

This is a DHCP snooping question, concerning a very useful security feature that protects the network from rogue DHCP servers. When the DHCP Option 82 feature is enabled on the switch with the command ip dhcp snooping information option, a subscriber is identified by the switch port through which it connects to the network and by its MAC address. DHCP snooping also facilitates a rate-limiting feature for DHCP requests to prevent a DHCP denial of services (DoS) by excessive false requests from a host that would have the “gobbler effect” of requesting numerous leases from the same port. The question includes a couple of points that could easily be overlooked if you are suffering from exam pressure: Namely, the ports are actually required to be configured with the command switchport host (or by configuring portfast) to set the port mode to access and to forward immediately and the rate limiting is configured in packets per second, not per minute, as implied. So, you need to pay attention to detail. If you have configured this correctly, as shown in Example 1-7, you have scored 6 points.

Example 1-7  Switches 1, 2, 3, and 4 DHCP Snooping Configuration

SW1(config)# ip dhcp snooping
SW1(config)# ip dhcp snooping vlan 300
SW1(config)# ip dhcp snooping information option
SW1(config)# int fastEthernet 0/18
SW1(config-if)# ip dhcp snooping trust
SW1(config)# interface range fastEthernet 0/11-17
SW1(config-if-range)# ip dhcp snooping limit rate 10
SW1(config)# interface range fastEthernet 0/11-18
SW1(config-if-range)# switchport host
SW1(config-if-range)# switchport access vlan 300
Example 1-7  Switches 1, 2, 3, and 4 DHCP Snooping Configuration  continued

SW2(config)# ip dhcp snooping
SW2(config)# ip dhcp snooping vlan 300
SW2(config)# ip dhcp snooping information option
SW2(config)# interface range fastEthernet 0/11-17
SW2(config-if-range)# ip dhcp snooping limit rate 10
SW2(config-if-range)# switchport host
SW2(config-if-range)# switchport access vlan 300

SW3(config)# ip dhcp snooping
SW3(config)# ip dhcp snooping vlan 300
SW3(config)# ip dhcp snooping information option
SW3(config)# interface range fastEthernet 0/11-17
SW3(config-if-range)# ip dhcp snooping limit rate 10
SW3(config-if-range)# switchport host
SW3(config-if-range)# switchport access vlan 300

SW4(config)# ip dhcp snooping
SW4(config)# ip dhcp snooping vlan 300
SW4(config)# ip dhcp snooping information option
SW4(config)# interface range fastEthernet 0/11-17
SW4(config-if-range)# ip dhcp snooping limit rate 10
SW4(config-if-range)# switchport host
SW4(config-if-range)# switchport access vlan 300

SW1# sh ip dhcp snooping
Switch DHCP snooping is enabled
DHCP snooping is configured on following VLANs:
Example 1-7  Switches 1, 2, 3, and 4 DHCP Snooping Configuration  continued

300

Insertion of option 82 is enabled

- circuit-id format: vlan-mod-port
- remote-id format: MAC

Option 82 on untrusted port is not allowed

Verification of hwaddr field is enabled

<table>
<thead>
<tr>
<th>Interface</th>
<th>Trusted</th>
<th>Rate limit (pps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FastEthernet0/11</td>
<td>no</td>
<td>10</td>
</tr>
<tr>
<td>FastEthernet0/12</td>
<td>no</td>
<td>10</td>
</tr>
<tr>
<td>FastEthernet0/13</td>
<td>no</td>
<td>10</td>
</tr>
<tr>
<td>FastEthernet0/14</td>
<td>no</td>
<td>10</td>
</tr>
<tr>
<td>FastEthernet0/15</td>
<td>no</td>
<td>10</td>
</tr>
<tr>
<td>FastEthernet0/16</td>
<td>no</td>
<td>10</td>
</tr>
<tr>
<td>FastEthernet0/17</td>
<td>no</td>
<td>10</td>
</tr>
<tr>
<td>FastEthernet0/18</td>
<td>yes</td>
<td>unlimited</td>
</tr>
</tbody>
</table>

- For additional security, ensure that the user ports on switches 1–4 (Fast Ethernet ports 0/11-17) can only communicate with the network with IP addresses gained from the DHCP feature configured previously. Use a dynamic feature to ensure that the only information forwarded upon connection is DHCP request packets and then any traffic that matches the DHCP IP information received from the DHCP binding for additional security. (3 points)

A complementary feature to DHCP snooping is IP Source Guard. This feature binds the information received from the DHCP address offered and effectively builds a dynamic VLAN access control list (VACL) on a per-port basis to allow only source traffic matched from the DHCP offer to ingress the switch port for additional security. If you have configured this correctly, as shown in Example 1-8, you have scored 3 points.
Example 1-8  Switch 1, 2, 3, and 4 IP Source Guard Configuration

SW1(config)# interface range fast 0/11-17
SW1(config-if-range)# ip verify source

SW2(config)# interface range fast 0/11-17
SW2(config-if-range)# ip verify source

SW3(config)# interface range fast 0/11-17
SW3(config-if-range)# ip verify source

SW4(config)# interface range fast 0/11-17
SW4(config-if-range)# ip verify source

R5 and R6 have been preconfigured with IP addresses on their Ethernet interfaces. Configure R4 and its associated switch port accordingly without using secondary addressing to communicate with R5 and R6. Configure R4 with an IP address of 120.100.45.4/24 to communicate with R5, and configure R4 with an IP address of 120.100.46.4/24 to communicate with R6. Configure R4 Gi0/1 and switch 2 FE0/4 only. (3 points)

This is just a simple trunking question on switch 2 to R4 to enable R4 to connect to VLAN45 and VLAN46. One point to bear in mind is that switch 2 does not have VLAN45 and VLAN46 configured locally within the default configuration, so you need to create the VLANs locally prior to configuring the trunk. If you have configured this correctly, as shown in Example 1-9, you have scored 3 points.

Example 1-9  Switch 2 and R4 Trunking Configuration

R4(config)# interface GigabitEthernet0/1.45
R4(config-if)# encapsulation dot1Q 45
R4(config-if)# ip address 120.100.45.4 255.255.255.0
R4(config-if)# interface GigabitEthernet0/1.46
R4(config-if)# encapsulation dot1Q 46
Example 1-9  Switch 2 and R4 Trunking Configuration  

R4(config-if)# ip address 120.100.46.4 255.255.255.0

SW2(config)# vlan 45-46
SW2(config)# interface FastEthernet0/4
SW2(config-if)# switchport trunk encapsulation dot1q
SW2(config-if)# switchport trunk allowed vlan 45,46
SW2(config-if)# switchport mode trunk

Your initial Frame Relay configuration has been supplied for the R1-R2-R3 connectivity and R2–R5. Configure each device as per Figure 1-6 to ensure that each device is reachable over the Frame Relay network. Use only the indicated DLCIs. (2 points)

The initial Frame Relay configuration has been supplied for you; all you need to add is additional maps on R1 and R2 spokes to enable them to communicate with each other by directing traffic to the hub router (R3) because the initial configuration uses no inverse arp. Communication between R2 and R5 works without modification by default. If you have configured this correctly, as shown in Example 1-10, you have scored 2 points.

Example 1-10  R1 and R2 Additional Frame Relay Configuration and Testing

R1# conf t
R1(config)# int s0/0/0
R1(config-if)# frame-relay map ip 120.100.123.2 103 broadcast

R2# conf t
Enter configuration commands, one per line. End with CNTL/Z.
R2(config)# int s0/0
R2(config-if)# frame-relay map ip 120.100.123.1 203 broadcast
Example 1-10  R1 and R2 Additional Frame Relay Configuration and Testing  continued

R1# ping 120.100.123.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 120.100.123.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/8/8 ms

Section 2: IPv4 IGP Protocols (22 Points)
In this section, you will be answering questions about EIGRP, OSPF, and redistribution between these protocols.

Section 2.1: OSPF

- Use a process ID of 1. Where possible, all OSPF configurations should not be configured under the process ID. Do not change the preconfigured interface types where applicable. Configure the loopback interfaces of routers R1, R2, and R3 to be in area 0, R4 in area 34, and R5 in area 5. (2 points)

Recent advances in OSPF have allowed configuration of the network area directly under the interface as opposed to within the OSPF process. Example 1-11 details the OSPF configuration.

Example 1-11  OSPF Configuration

R1(config)# interface GigabitEthernet 0/1
R1(config-if)# ip ospf 1 area 100
R1(config)# interface Serial 0/0/0
R1(config-if)# ip ospf 1 area 0
Example 1-11  OSPF Configuration  

---

R1(config-if)# interface Loopback 0
R1(config-if)# ip ospf 1 area 0

R2(config-if)# interface Loopback 0
R2(config-if)# ip ospf 1 area 0
R2(config-if)# interface Serial 0/0
R2(config-if)# ip ospf 1 area 0
R2(config-if)# interface Serial 0/1
R2(config-if)# ip ospf 1 area 5
R2(config-if)# interface FastEthernet 0/1
R2(config-if)# ip ospf 1 area 200

R3(config-if)# interface loopback 0
R3(config-if)# ip ospf 1 area 0
R3(config-if)# interface Serial 0/0/0
R3(config-if)# ip ospf 1 area 0
R3(config-if)# interface GigabitEthernet 0/0
R3(config-if)# ip ospf 1 area 34

R4(config-if)# interface Loopback 0
R4(config-if)# ip ospf 1 area 34
R4(config-if)# interface GigabitEthernet 0/0
R4(config-if)# ip ospf 1 area 34
R4(config-if)# interface GigabitEthernet 0/1.45
R4(config-if)# ip ospf 1 area 5

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Example 1-11  OSPF Configuration  continued

R6(config)# interface Loopback 0
R6(config-if)# ip ospf 1 area 5
R6(config-if)# interface GigabitEthernet 0/0
R6(config-if)# ip ospf 1 area 5
R6(config-if)# interface Serial 0/0/1
R6(config-if)# ip ospf 1 area 5

Initial configuration changes the OSPF network interface types on router R1, R2, and R3 Frame Relay interfaces. This changes the hello and dead interval timers, which results in a mismatch with neighbor relationship never being formed. Example 1-12 shows the differing interface parameters between routers and required configuration on routers R1 and R3. Because you are not able to change the network type, you must manually adjust the OSPF hello interval. The most logical place to do this is on the hub router R3 to ensure a common configuration. If you have configured OSPF correctly, as shown in Examples 1-11 and 1-12, you have scored 2 points.

Example 1-12  OSPF Interface Parameters and Configuration

R1# show ip ospf interface Serial 0/0/0
Serial0/0/0 is up, line protocol is up
   Internet Address 120.100.123.1/24, Area 0
   Process ID 1, Router ID 120.100.1.1, Network Type POINT_TO_POINT, Cost: 64
   Enabled by interface config, including secondary ip addresses
   Transmit Delay is 1 sec, State POINT_TO_POINT
   Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
   oob-resync timeout 40
   Hello due in 00:00:08
   Supports Link-local Signaling (LLS)
   Cisco NSF helper support enabled
   IETF NSF helper support enabled
   Index 1/2, flood queue length 0
   Next 0x0(0)/0x0(0)
Example 1-12  OSPF Interface Parameters and Configuration  continued

Last flood scan length is 0, maximum is 0
Last flood scan time is 0 msec, maximum is 0 msec
Neighbor Count is 0, Adjacent neighbor count is 0
Suppress hello for 0 neighbor(s)

R3# show ip ospf interface Serial 0/0/0
Serial0/0/0 is up, line protocol is up
  Internet Address 120.100.123.3/24, Area 0
  Process ID 1, Router ID 120.100.3.1, Network Type POINT_TO_MULTIPOINT, Cost: 64
  Enabled by interface config, including secondary ip addresses
  Transmit Delay is 1 sec, State POINT_TO_MULTIPOINT
  Timer intervals configured, Hello 30, Dead 120, Wait 120, Retransmit 5
    oob-resync timeout 120
    Hello due in 00:00:08
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 2/2, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 0, maximum is 0
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 0, Adjacent neighbor count is 0
  Suppress hello for 0 neighbor(s)

R3# conf t
R3(config)# int Serial 0/0/0
R3(config-if)# ip ospf hello-interval 10
R3# sh ip ospf neighbor
Example 1-12  OSPF Interface Parameters and Configuration  

<table>
<thead>
<tr>
<th>Neighbor ID</th>
<th>Pri</th>
<th>State</th>
<th>Dead Time</th>
<th>Address</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>120.100.1.1</td>
<td>0</td>
<td>FULL/</td>
<td>00:00:32</td>
<td>120.100.123.1</td>
<td>Serial0/0/0</td>
</tr>
<tr>
<td>120.100.2.1</td>
<td>0</td>
<td>FULL/</td>
<td>00:00:35</td>
<td>120.100.123.2</td>
<td>Serial0/0/0</td>
</tr>
<tr>
<td>120.100.4.1</td>
<td>1</td>
<td>FULL/BDR</td>
<td>00:00:39</td>
<td>120.100.34.4</td>
<td>GigabitEthernet0/0</td>
</tr>
</tbody>
</table>

- No loopback networks should be advertised as host routes. (1 point)

Loopback interfaces within OSPF are by default advertised as host routes. To manipulate this behavior, you must override the network type that the IOS associates with the loopback interface. Example 1-13 shows the host routes learned on R2. Note that 120.100.123.3/32 is actually a host route generated by OSPF for the Frame Relay connection, so this is expected behavior and acceptable in the routing table. If you have configured this correctly, as shown in Example 1-13, you have scored 1 point.

Example 1-13  OSPF Loopback Interface Host Routes and Configuration

R2# sh ip route | include  /32
0 120.100.5.1/32 [110/65] via 120.100.25.5, 00:04:34, Serial0/1
0 IA 120.100.4.1/32 [110/68] via 120.100.123.3, 00:00:42, Serial0/0
0 120.100.1.1/32 [110/129] via 120.100.123.3, 00:01:00, Serial0/0
0 120.100.3.1/32 [110/65] via 120.100.123.3, 00:01:00, Serial0/0
0 120.100.123.3/32 [110/64] via 120.100.123.3, 00:01:00, Serial0/0

R1# conf t
R1(config)# int Loopback 0
R1(config-if)# ip ospf network point-to-point
Example 1-13  OSPF Loopback Interface Host Routes and Configuration  continued

R2# conf t
R2(config)# interface Loopback 0
R2(config-if)# ip ospf network point-to-point

R3# conf t
R3(config)# int Loopback 0
R3(config-if)# ip ospf network point-to-point

R4# conf t
R4(config)# int Loopback 0
R4(config-if)# ip ospf network point-to-point

R5# conf t
R5(config)# int Loopback 0
R5(config-if)# ip ospf network point-to-point

R2# sh ip route ospf 1 | include /24
150.100.0.0/24 is subnetted, 2 subnets
  0 IA 120.100.4.0/24 [110/66] via 120.100.123.3, 00:00:43, Serial0/0
  0 120.100.5.0/24 [110/65] via 120.100.25.5, 00:01:40, Serial0/1
  0 120.100.1.0/24 [110/69] via 120.100.25.3, 00:00:43, Serial0/0
  0 120.100.3.0/24 [110/65] via 120.100.123.3, 00:00:43, Serial0/0
  0 120.100.45.0/24 [110/65] via 120.100.25.5, 00:01:40, Serial0/1
  0 IA 120.100.34.0/24 [110/65] via 120.100.123.3, 00:00:43, Serial0/0
  0 IA 120.100.100.0/24 [110/69] via 120.100.123.3, 00:00:00, Serial0/0
Ensure that R1 does not advertise the preconfigured secondary address under interface Gigabit 0/1 of 120.100.100.1/24 to the OSPF network. Do not use any filtering techniques to achieve this. (2 points)

The associated behavior with configuring OSPF directly under the interface is that by default it advertises any secondary addresses assigned to the interface. R1 has a preconfigured secondary address on interface Gigabit 0/1, which is therefore advertised. Because you cannot filter this advertisement, you must inform OSPF not to include the secondary addresses under the interface command. If you have configured this correctly, as shown in Example 1-14, you have scored 2 points.

Example 1-14  OSPF Secondary Address Advertisement and Configuration

```
R1# show ip ospf int GigabitEthernet 0/1
GigabitEthernet0/1 is up, line protocol is up
   Internet Address 150.100.1.1/24, Area 100
   Process ID 1, Router ID 120.100.1.1, Network Type BROADCAST, Cost: 1
   Enabled by interface config, including secondary ip addresses
   Transmit Delay is 1 sec, State DR, Priority 1
   Designated Router (ID) 120.100.1.1, Interface address 150.100.1.1
   No backup designated router on this network
   Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
   oob-resync timeout 40
   Hello due in 00:00:00
   Supports Link-local Signaling (LLS)
   Cisco NSF helper support enabled
   IETF NSF helper support enabled
   Index 1/1, flood queue length 0
   Next 0x0(0)/0x0(0)
   Last flood scan length is 0, maximum is 0
   Last flood scan time is 0 msec, maximum is 0 msec
   Neighbor Count is 0, Adjacent neighbor count is 0
```
Example 1-14  OSPF Secondary Address Advertisement and Configuration  continued

Suppress hello for 0 neighbor(s)

R1(config)# interface GigabitEthernet 0/1
R1(config-if)# ip ospf 1 area 100 secondaries none

R2# sh ip route 120.100.100.0
% Subnet not in table

R5 should use the Frame Relay link within area 5 for its primary communication to the OSPF network. If this network should fail either at Layer 1 or Layer 2, R5 should form a neighbor relationship with R4 under area 5 to maintain connectivity. Your solution should be dynamic, ensuring that while the area 5 frame relay link is operational, no neighbor relationship exists between R4 and R5. However the Ethernet interfaces of R4 and R5 must remain up. To confirm the operational status of the Frame Relay network, you should ensure that the serial interface of R5 is reachable by configuration of R5. You are permitted to define neighbor statements between R5 and R4. (4 points)

This is a complex scenario, one that really consumes your time. However, all the clues are in the question, so some lateral thinking is required. You can rule out a backup interface solution because the Ethernet needs to remain up and the solution must cater for Layer 1 and Layer 2 rather than purely for Layer 1. Similarly, a demand scenario is also out because this would involve a neighbor relationship being formed.

You are also requested to confirm operational status of the Frame Relay interface on R5 with your overall solution being dynamic. This takes a great deal of effort and trial and error, but you can use the IP SLA feature to monitor the IP address of the Frame Relay interface on R5 by R5 itself. If this responds to the automatic polling with Internet Control Message Protocol (ICMP), you know the Frame Relay is up at Layers 1 and 2. (Layer 2 also needs to be up for a valid response because the ICMP packet is sent over the Frame Relay network and a local map to R5’s own IP address is required for this.) If the polling fails, you know the interface is down. IP SLA can then be used to inform the router, and a forwarding decision can be manipulated. This feature is known as Policy Based Routing (PBR) Support with Multiple Tracking Options. This gives PBR access to all the objects that are available through the tracking process.
The tracking process provides the ability to track individual objects such as ICMP ping reachability and to inform the required PBR process when an object state changes. So, in summary, if the object status changes, R5 can simply manipulate the way it sends traffic by policy routing. The traffic it manipulates must be OSPF; it should be directed to R4 to form the adjacency over the Ethernet network (VLAN45). So, when R5 Frame Relay is up and running, you just need to break the adjacency between R5 and R4. When the Frame Relay fails, you need to allow the adjacency between R5 and R4 to form. The first step in this solution is to configure the IP SLA object tracking on R5. Remember, the additional map is needed locally so that it can ping its own serial interface. This configuration is detailed in Example 1-15.

**Example 1-15  R5 IP SLA Configuration and Status**

```
R5(config)# interface Serial0/0/1
R5(config-if)# frame-relay map ip 120.100.25.5 512 broadcast
R5(config-if)# exit
R5(config)# ip sla 1
R5(config-ip-sla)# icmp-echo 120.100.25.5
R5(config-ip-sla-echo)# ip sla schedule 1 life forever start-time now
R5(config)# track 1 rtr 1 reachability

R5# show ip sla statistics

Round Trip Time (RTT) for   Index 1
                           Latest RTT: 4 milliseconds
Latest operation start time: *21:17:10.683 UTC Mon Feb 19 2007
Latest operation return code: OK
Number of successes: 2
Number of failures: 0
Operation time to live: Forever
```
OSPF must be configured between R4 and R5 with manual neighbor statements, as directed in the question, that ensure the routers unicast traffic to each other. To do this, you must change the network type to nonbroadcast. The unicast traffic between neighbors can be identified by an ACL that the PBR process can match, and then instead of allowing normal traffic flow between R5 and R4 to form the neighbor relationship, the next hop can be modified. Because the OSPF TTL is set to 1 by default, the traffic is effectively dropped by the next hop, and the OSPF between R5 and R4 never establishes. Similarly, when the object tracking fails, the PBR process is overridden, and traffic can flow as per normal. This then allows R5 and R4 to form an OSPF adjacency.

So, if you use the PBR command set ip next-hop verify-availability 120.100.25.2 10 track 1, R5 can forward normal OSPF traffic to 120.100.25.2 (R2 Frame Relay) to effectively discard the traffic if the tracked object (1) is up. If the object status changes to down, the PBR process is informed and the OSPF traffic to 120.100.25.2 follows the usual next hop. R5 must be configured to locally policy route traffic as normal PBR behavior for traffic manipulation for traffic that flows through the router rather than traffic that is generated by the router itself. Example 1-16 shows the required OSPF configuration on R4 and R5, the PBR on R5, a debug of R2 sending TTL expired to R5 after the OSPF traffic is sent to R2 instead of R5, and the resulting neighbor partial adjacency that is formed between R4 and R5.

Example 1-16 R4 and R5 OSPF and PBR Configuration

R4(config)# interface GigabitEthernet0/1.45
R4(config-if)# ip ospf network non-broadcast
R4(config-if)# router ospf 1
R4(config-router)# neighbor 120.100.45.5

R5(config)# interface GigabitEthernet0/0
R5(config-if)# ip ospf network non-broadcast
R5(config-if)# router ospf 1
R5(config-router)# neighbor 120.100.45.4
R5(config-router)# exit

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Example 1-16  R4 and R5 OSPF and PBR Configuration  continued

R5(config)# access-list 100 permit ospf host 120.100.45.5 host 120.100.45.4
R5(config)# route-map TEST permit 10
R5(config-route-map)# match ip address 100
R5(config-route-map)# set ip next-hop verify-availability 120.100.25.2 10 track 1
R5(config-route-map)# interface GigabitEthernet0/0
R5(config-route-map)# ip policy route-map TEST
R5(config-if)# exit
R5(config)# ip local policy route-map TEST

R2# debug ip icmp
ICMP packet debugging is on
R2#

*Feb 26 22:17:12.847:  ICMP: time exceeded (time to live) sent to 120.100.45.5 (dest was 120.100.45.4)
R2#

R5# show ip ospf neigh

<table>
<thead>
<tr>
<th>Neighbor ID</th>
<th>Pri</th>
<th>State</th>
<th>Dead Time</th>
<th>Address</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>120.100.2.1</td>
<td>0</td>
<td>FULL/DR</td>
<td>00:00:37</td>
<td>120.100.25.2</td>
<td>Serial0/0/1</td>
</tr>
<tr>
<td>120.100.4.1</td>
<td>1</td>
<td>INIT/DROTHER</td>
<td>00:01:45</td>
<td>120.100.45.4</td>
<td>GigabitEthernet0/0</td>
</tr>
</tbody>
</table>

Example 1-17 shows the OSPF adjacency being formed when the Frame Relay between R2 and R5 is shut down on R5. The PBR is overridden, and normal routing occurs because the next hop is not being verified by the object tracking. If your routing table isn’t an exact replica of that shown in Example 1-17, did you remember that when an OSPF adjacency forms between R5 and R2, you are running from area 5 into area 34? So, you need a virtual link between R3 and R4 to
extend area 0. If you didn’t remember, it’s an easy mistake that would take your points away. It’s a very difficult question, but a good one to practice with and examine how features operate and interact with each other. You might have been scratching your head or cursing, but you likely learned something new from this question.

If you configured this correctly, including the virtual link, you have scored 4 points. This is definitely a question worth leaving to the end of your exam when hopefully you have time left over to experiment.

Example 1-17  R3 and R4 OSPF Virtual Link Configuration and R5 Test

R3(config)# router ospf 1
R3(config-router)# area 34 virtual-link 120.100.4.1

R4(config)# router ospf 1
R4(config-router)# area 34 virtual-link 120.100.3.1

R5(config)# interface s0/0/1
R5(config-if)# shut
R5(config-if)#
*Jan 2 21:58:16.811: %OSPF-5-ADJCHG: Process 1, Nbr 120.100.2.1 on Serial0/0/1 from FULL to DOWN, Neighbor Down: Interface down or detached
*Jan 2 21:58:16.807: %LINK-5-CHANGED: Interface Serial0/0/1, changed state to administratively down
*Jan 2 21:58:19.807: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1, changed state to down
R5(config-if)# do show ip ospf neigh

<table>
<thead>
<tr>
<th>Neighbor ID</th>
<th>Pri</th>
<th>State</th>
<th>Dead Time</th>
<th>Address</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>0</td>
<td>ATTEMPT/DROTHER</td>
<td>00:00:33</td>
<td>120.100.45.4 GigabitEthernet0/0</td>
<td></td>
</tr>
</tbody>
</table>

R5(config-if)#
*Jan 2 21:59:43.547: %OSPF-5-ADJCHG: Process 1, Nbr 0.0.0.0 on GigabitEthernet0/0 from ATTEMPT to DOWN, Neighbor Down: Dead timer expired
R5(config-if)#
Example 1-17  R3 and R4 OSPF Virtual Link Configuration and R5 Test  continued

*Jan  2 22:00:08.135: %OSPF-5-ADJCHG: Process 1, Nbr 120.100.4.1 on GigabitEthernet0/0 from LOADING to FULL, Loading Done
R5(config-if)#

R5# show route ospf
  150.100.0.0/24 is subnetted, 3 subnets
  0 IA 150.100.2.0 [110/67] via 120.100.45.4, 00:09:41, GigabitEthernet0/0
  0 IA 150.100.1.0 [110/67] via 120.100.45.4, 00:09:41, GigabitEthernet0/0
  120.0.0.0/8 is variably subnetted, 13 subnets, 2 masks
  0 IA 120.100.25.0/24
    [110/130] via 120.100.45.4, 00:09:41, GigabitEthernet0/0
  0 IA 120.100.4.1/32 [110/2] via 120.100.45.4, 00:09:41, GigabitEthernet0/0
  0 IA 120.100.1.0/24 [110/67] via 120.100.45.4, 00:09:41, GigabitEthernet0/0
  0 IA 120.100.2.0/24 [110/67] via 120.100.45.4, 00:09:41, GigabitEthernet0/0
  0 IA 120.100.3.0/24 [110/3] via 120.100.45.4, 00:09:41, GigabitEthernet0/0
  0 IA 120.100.34.0/24 [110/2] via 120.100.45.4, 00:09:41, GigabitEthernet0/0
  0 IA 120.100.123.3/32
    [110/2] via 120.100.45.4, 00:09:41, GigabitEthernet0/0
  0 IA 120.100.123.0/24
    [110/130] via 120.100.45.4, 00:09:41, GigabitEthernet0/0

Section 2.2: EIGRP

- Configure EIGRP using an AS number of 1. The loopback interfaces of all routers and switches should be advertised within EIGRP. (2 points)
This is not a difficult question by any means, but it’s one that has a magnitude of configuration and sets up your EIGRP network for the following questions. You must remember to include your preconfigured loopback interfaces and enable routing on the Layer 3 switches. Use the `show ip eigrp neighbor` command to verify your peering prior to moving onto the next question. If you have configured this correctly, as shown in Example 1-18, you have scored 2 points.

**Example 1-18  EIGRP Configuration**

```bash
R4# sh run | beg eigrp
router eigrp 1
 network 120.100.4.1 0.0.0.0
 network 120.100.45.4 0.0.0.0
 network 120.100.46.4 0.0.0.0
 no auto-summary

R5# sh run | beg eigrp
router eigrp 1
 passive-interface Loopback0
 network 120.100.5.1 0.0.0.0
 network 120.100.45.5 0.0.0.0
 network 150.100.3.5 0.0.0.0
 no auto-summary

R6# sh run | beg eigrp
router eigrp 1
 network 120.100.6.1 0.0.0.0
 network 120.100.46.6 0.0.0.0
 network 150.100.3.6 0.0.0.0
 no auto-summary
```

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Example 1-18  EIGRP Configuration  continued

SW1(config)# ip routing
SW1(config)# exit
SW1# sh run | beg eigrp
router eigrp 1
  network 120.100.7.1 0.0.0.0
  network 150.100.3.7 0.0.0.0
  no auto-summary

SW2(config)# ip routing
SW2(config)# exit
SW2# sh run | beg eigrp
router eigrp 1
  network 120.100.8.1 0.0.0.0
  network 150.100.3.8 0.0.0.0
  no auto-summary

SW3(config)# ip routing
SW3(config)# exit
SW3# sh run | beg eigrp
router eigrp 1
  network 120.100.9.1 0.0.0.0
  network 150.100.3.9 0.0.0.0
  no auto-summary
Example 1-18  EIGRP Configuration  continued

SW4(config)# ip routing
SW4(config)# exit
SW4# sh run | beg eigrp
router eigrp 1
  network 120.100.10.1 0.0.0.0
  network 150.100.3.10 0.0.0.0
no auto-summary

Ensure that R4 does not install any of the EIGRP loopback routes from any of the switches into its routing table. As such, these routes should also not be present in the OSPF network post redistribution. Do not use any route-filtering access control lists (ACL), prefix lists, or admin distance manipulation to achieve this and perform configuration only on R4. (3 points)

A distribute or prefix list is the obvious choice here, but this is not permitted. Upon close inspection of the loopback routes within Example 1-19, you can notice that the routes have a hop count of 2 associated with them. Hop count isn’t something you naturally assimilate with EIGRP, but you can configure the process to ignore routes received with a hop count larger than a configured threshold with the command metric maximum-hops. By configuring the maximum hop count of 1 on R4, you can simply stop the loopback routes from entering the process. If you have configured this correctly, as shown in Example 1-19, you have scored 3 points.

Example 1-19  EIGRP maximum-hops Configuration

R4# show ip route eigrp
  150.100.0.0/24 is subnetted, 3 subnets
D  150.100.3.0
    [90/30] via 120.100.46.6, 00:00:10, GigabitEthernet0/1.48
    [90/30] via 120.100.45.5, 00:00:10, GigabitEthernet0/1.45
120.0.0.0/8 is variably subnetted, 16 subnets, 2 masks
### Example 1-19  EIGRP maximum-hops Configuration  continued

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>120.100.8.0/24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[90/158720] via 120.100.46.6, 00:00:10, GigabitEthernet0/1.46</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>120.100.9.0/24</td>
<td></td>
</tr>
<tr>
<td>[90/158720] via 120.100.46.6, 00:00:10, GigabitEthernet0/1.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>120.100.10.0/24</td>
<td></td>
</tr>
<tr>
<td>[90/158720] via 120.100.46.6, 00:01:07, GigabitEthernet0/1.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>120.100.5.0/24</td>
<td></td>
</tr>
<tr>
<td>[90/156160] via 120.100.45.5, 00:00:10, GigabitEthernet0/1.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>120.100.6.0/24</td>
<td></td>
</tr>
<tr>
<td>[90/156160] via 120.100.46.6, 00:00:10, GigabitEthernet0/1.46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>120.100.7.0/24</td>
<td></td>
</tr>
<tr>
<td>[90/158720] via 120.100.46.6, 00:00:10, GigabitEthernet0/1.46</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R4# show ip route 120.100.8.0
Routing entry for 120.100.8.0/24
   Known via 'eigrp 1', distance 90, metric 158720, type internal
   Redistributing via ospf 1, eigrp 1
   Advertised by ospf 1 metric 50000 subnets
   Last update from 120.100.46.6 on GigabitEthernet0/1.46, 00:00:15 ago
   Routing Descriptor Blocks:
   * 120.100.46.6, from 120.100.46.6, 00:00:15 ago, via GigabitEthernet0/1.46
     Route metric is 158720, traffic share count is 1
     Total delay is 5200 microseconds, minimum bandwidth is 100000 Kbit

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Example 1-19  EIGRP maximum-hops Configuration  continued

Reliability 255/255, minimum MTU 1500 bytes
Loading 1/255, Hops 2

R4# show ip route 120.100.9.0
Routing entry for 120.100.9.0/24
  Known via 'eigrp 1', distance 90, metric 158720, type internal
  Redistributing via ospf 1, eigrp 1
  Advertised by ospf 1 metric 5000 subnets
  Last update from 120.100.46.6 on GigabitEthernet0/1.46, 00:00:25 ago
  Routing Descriptor Blocks:
* 120.100.46.6, from 120.100.46.6, 00:00:25 ago, via GigabitEthernet0/1.46
    Route metric is 158720, traffic share count is 1
    Total delay is 5200 microseconds, minimum bandwidth is 100000 Kbit
    Reliability 255/255, minimum MTU 1500 bytes
    Loading 1/255, Hops 2

R4(config)# router eigrp 1
R4(config-router)# metric maximum-hops 1
R4(config-router)# do show ip route eigrp
  150.100.0.0/24 is subnets, 3 subnets
  D  150.100.3.0
    [90/30720] via 120.100.46.6, 00:00:04, GigabitEthernet0/1.46
    [90/30720] via 120.100.45.5, 00:00:04, GigabitEthernet0/1.45
  120.0.0.0/8 is variably subnets, 13 subnets, 2 masks
  D  120.100.5.0/24
    [90/156160] via 120.100.45.5, 00:00:04, GigabitEthernet0/1.45
  D  120.100.6.0/24
    [90/156160] via 120.100.46.6, 00:00:04, GigabitEthernet0/1.46

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R4 will have dual equal-cost routes to VLAN300 (network 150.100.3.0) from R5 and R6. Ensure that R4 sends traffic to this destination network to R5 rather than load sharing. Should the route from R5 become unavailable, traffic should be sent to R6. Do not policy route, alter the bandwidth or delay statements on R4’s interfaces, or use an offset list. Perform your configuration on R4 only. Your solution should be applied to all routes received from R5 and R6 as opposed to solely to the route to network VLAN300. (3 points)

To receive identical routes, your topology must have identical interface types or bandwidth statements used on R4, R5, and R6. Example 1-20 shows the VLAN300 route (150.100.3.0/24) received on R4 from both R5 and R6 with a metric of 30720. If you wanted to manipulate this route, the usual best practice method would be to modify the bandwidth or delay on one of the Ethernet interfaces, but this is not permitted. In fact, you are left with only one method that can be applied on R4 that influences all routes from R5 and R6 as opposed to just this individual route.

A route map is required to override the EIGRP assigned metrics assigned to routes on one interface by manipulating the bandwidth assigned to Gigabit 1/0.45. Gigabit 1/0.46 by default has a lower bandwidth assigned to routes received from it from the permit 20 statement in the route map. The route map is applied inbound to the process as a distribute list. Example 1-20 also shows that when the interface Gigabit 0/0 is shut down on R5, the route for VLAN300 is still received from R6 (R4’s feasible successor), so the route is still available, but with a different metric. If you have configured this correctly, as shown in Example 1-20, you have scored 3 points. (You could have also manipulated the delay within the route map or created a statement for each individual interface as opposed to just Gigabit 1/0.45.)

Example 1-20  EIGRP Metric Manipulation Configuration

```
R4# sh ip route 150.100.3.0
Routing entry for 150.100.3.0/24
  Known via 'eigrp 1', distance 90, metric 30720, type internal
  Redistributing via ospf 1, eigrp 1
  Advertised by ospf 1 metric 5000 subnets
  Last update from 120.100.45.5 on GigabitEthernet0/1.45, 00:25:40 ago
  Routing Descriptor Blocks:
    * 120.100.46.8, from 120.100.46.8, 00:25:40 ago, via GigabitEthernet0/1.46
```
Example 1-20  EIGRP Metric Manipulation Configuration  continued

Route metric is 30720, traffic share count is 1
Total delay is 200 microseconds, minimum bandwidth is 100000 Kbit
Reliability 254/255, minimum MTU 1500 bytes
Loading 1/255, Hops 1
120.100.45.5, from 120.100.45.5, 00:25:40 ago, via GigabitEthernet0/1.45
Route metric is 30720, traffic share count is 1
Total delay is 200 microseconds, minimum bandwidth is 100000 Kbit
Reliability 252/255, minimum MTU 1500 bytes
Loading 1/255, Hops 1

R4(config)# route-map CHANGE-METRIC permit 10
R4(config-route-map)# match interface gigabitEthernet 0/1.45
R4(config-route-map)# set metric 2000 10 255 1 1500
R4(config-route-map)# route-map CHANGE-METRIC permit 20
R4(config-route-map)# set metric 1000 10 255 1 1500
R4(config-route-map)# router eigrp 1
R4(config-router)# distribute-list route-map CHANGE-METRIC in
R4(config-router)# ^Z
R4# clear ip route *
R4# sh ip route 150.100.3.0
Routing entry for 150.100.3.0/24
    Known via 'eigrp 1', distance 90, metric 1282560, type internal
    Redistributing via ospf 1, eigrp 1
    Advertised by ospf 1 metric 5000 subnets
    Last update from 120.100.45.5 on GigabitEthernet0/1.45, 00:03:10 ago
    Routing Descriptor Blocks:
* 120.100.45.5, from 120.100.45.5, 00:03:10 ago, via GigabitEthernet0/1.45
    Route metric is 1282560, traffic share count is 1
Example 1-20  EIGRP Metric Manipulation Configuration

Total delay is 100 microseconds, minimum bandwidth is 2000 Kbit
Reliability 255/255, minimum MTU 1500 bytes
Loading 1/255, Hops 1

R5(config)# int gig0/0
R5(config-if)# shutdown

R4# sh ip route 150.100.3.0
Routing entry for 150.100.3.0/24
  Known via 'eigrp 1', distance 90, metric 2552560, type internal
  Redistributing via ospf 1, eigrp 1
  Advertised by ospf 1 metric 5000 subnets
  Last update from 120.100.46.6 on GigabitEthernet0/1.46, 00:00:10 ago
  Routing Descriptor Blocks:
  * 120.100.46.6, from 120.100.46.6, 00:00:10 ago, via GigabitEthernet0/1.46
    Route metric is 2552560, traffic share count is 1
    Total delay is 100 microseconds, minimum bandwidth is 2000 Kbit
    Reliability 255/255, minimum MTU 1500 bytes
    Loading 1/255, Hops 1

Section 2.3: Redistribution

- Perform mutual redistribution of IGP protocols on R4. All routes should be accessible with the exception of the switch loopback networks because these should not be visible via R4 as noted in an earlier question. EIGRP routes redistributed within the OSPF network should remain with a fixed cost of 5000 throughout the network. (3 points)
This is a very simple redistribution question for the warm-up lab. You have only a single redistribution point (R4), so you have no concerns when using protocols such as EIGRP and OSPF with their inherent protection against routing loops. The fixed cost of 5000 is achieved by advertising redistributed routes into OSPF using a metric-type of 2, which is the default, so no specific configuration is required for this. The only points you need to consider when redistributing into OSPF are to use the subnets command to ensure classless redistribution and to use default metrics in each protocol. If you have configured this correctly, as shown in Example 1-21, you have scored 3 points.

Example 1-21  R4 Redistribution Configuration and Verification

```plaintext
R4(config)# router eigrp 1
R4(config-router)# redistribute ospf 1
R4(config-router)# default-metric 10000 100 255 1 1500
R4(config-router)# router ospf 1
R4(config-router)# redistribute eigrp 1 subnets
R4(config-router)# default-metric 5000

R1# show ip route ospf l include E2
0 E2 150.100.3.0 [110/5000] via 120.100.123.3, 00:00:46, Serial0/0/0
0 E2 120.100.6.0/24 [110/5000] via 120.100.123.3, 00:00:46, Serial0/0/0
0 E2 120.100.46.0/24 [110/5000] via 120.100.123.3, 00:00:46, Serial0/0/0

SW1# show ip route eigrp l include EX
D EX 150.100.2.0 [170/284416] via 150.100.3.6, 00:01:43, Vlan300
D EX 150.100.1.0 [170/284416] via 150.100.3.6, 00:01:43, Vlan300
D EX 120.100.25.0/24 [170/284416] via 150.100.3.6, 00:01:43, Vlan300
D EX 120.100.1.0/24 [170/284416] via 150.100.3.6, 00:01:43, Vlan300
D EX 120.100.2.0/24 [170/284416] via 150.100.3.6, 00:01:43, Vlan300
D EX 120.100.3.0/24 [170/284416] via 150.100.3.6, 00:01:43, Vlan300
D EX 120.100.34.0/24 [170/284416] via 150.100.3.6, 00:01:43, Vlan300
D EX 120.100.123.3/32 [170/284416] via 150.100.3.6, 00:01:43, Vlan300
D EX 120.100.123.0/24 [170/284416] via 150.100.3.6, 00:01:44, Vlan300
```
Configure R4 to redistribute up to only five EIGRP routes and generate a system warning when the fourth route is redistributed. Do not use any access lists in your solution. (2 points)

You can limit the number of prefixes redistributed into OSPF and generate a warning when the number of prefixes reaches a defined maximum by use of the `redistribute maximum-prefix` command. To generate the warning on the fourth route, you need to configure a percentage threshold (80 percent). If you have configured this correctly, as shown in Example 1-22, you have scored 2 points.

```
Example 1-22  R4 Prefix Configuration
R4(config)# router ospf 1
R4(config-router)# redistribute maximum-prefix 5 80
```

**Section 3: BGP (14 Points)**

Configure iBGP peering as follows: R1-R3, R2-R3, R6-R5, Sw1-R6, Sw1-R5. Use minimal configuration and use loopback interfaces for your peering. Configure eBGP peering as follows: R3-R4, R4-R6, R4-R5, R5-R2. Use minimal configuration and use loopback interfaces for your peering with the exception of R4 to R5. Use the AS numbers supplied in Figure 1-9. (2 points)

These are easy points, but you do lots of typing to earn them. You need to remember to use peer groups to minimize configuration where possible, namely on R3, R6, and switch 1, and follow the peering instructions closely because these are relevant for the following questions. You should have noticed that R3 was required to be a route reflector for iBGP peers R1 and R2 in AS10 and that no synchronization is required because the underlying IGP is not redistributed into BGP. Remember to verify your peering with the `show ip bgp neighbor` command. If you have configured this correctly, as shown in Example 1-23, you have scored 2 points.
Example 1-23  BGP Peering Configuration

R1# sh run | begin bgp
router bgp 10
    no synchronization
    neighbor 120.100.3.1 remote-as 10
    neighbor 120.100.3.1 update-source Loopback0
    no auto-summary

R2# sh run | begin bgp
router bgp 10
    no synchronization
    neighbor 120.100.3.1 remote-as 10
    neighbor 120.100.5.1 remote-as 300
    neighbor 120.100.5.1 ebgp-multihop 2
    neighbor 120.100.5.1 update-source Loopback0
    no auto-summary

R3# sh run | begin bgp
router bgp 10
    no synchronization
    neighbor IBGP peer-group
    neighbor IBGP remote-as 10
    neighbor IBGP update-source Loopback0
    neighbor IBGP route-reflector-client
    neighbor 120.100.1.1 peer-group IBGP
    neighbor 120.100.2.1 peer-group IBGP
    neighbor 120.100.4.1 remote-as 200
    neighbor 120.100.4.1 ebgp-multihop 2
    neighbor 120.100.4.1 update-source Loopback0
    no auto-summary
Example 1-23  BGP Peering Configuration  continued

R4# sh run | begin bgp
router bgp 200
  no synchronization
  neighbor 120.100.3.1 remote-as 10
  neighbor 120.100.3.1 ebgp-multihop 2
  neighbor 120.100.3.1 update-source Loopback0
  neighbor 120.100.6.1 remote-as 300
  neighbor 120.100.6.1 ebgp-multihop 2
  neighbor 120.100.6.1 update-source Loopback0
  neighbor 120.100.45.5 remote-as 300
  no auto-summary

R5# sh run | begin bgp
router bgp 300
  no synchronization
  neighbor 120.100.2.1 remote-as 10
  neighbor 120.100.2.1 ebgp-multihop 2
  neighbor 120.100.2.1 update-source Loopback0
  neighbor 120.100.6.1 remote-as 300
  neighbor 120.100.6.1 update-source Loopback0
  neighbor 120.100.45.6 remote-as 200
  neighbor 150.100.3.7 remote-as 300
  no auto-summary

R6# sh run | beg bgp
router bgp 300
Example 1-23  BGP Peering Configuration  

```
no synchronization
neighbor IBGP peer-group
neighbor IBGP remote-as 300
neighbor IBGP update-source Loopback0
neighbor 120.100.4.1 remote-as 200
neighbor 120.100.4.1 ebgp-multihop 2
neighbor 120.100.4.1 update-source Loopback0
neighbor 120.100.5.1 peer-group IBGP
neighbor 150.100.3.7 peer-group IBGP
no auto-summary
```

```
SW1# sh run | begin bgp
router bgp 300
  no synchronization
  neighbor IBGP peer-group
  neighbor IBGP remote-as 300
  neighbor 120.100.5.1 peer-group IBGP
  neighbor 120.100.6.1 peer-group IBGP
  no auto-summary
```

- AS200 is to be used as a backup transit network for traffic between AS100 and AS300. As such, if the Frame Relay network between R5 and R2 fails, ensure that the peering between R2 and R5 is not maintained via the Ethernet network. Do not use any ACL-type restrictions or change the existing peering. (2 points)

Because R2 and R5 peer to each other using their loopback interfaces, the peering is maintained if the Frame Relay network between R2 and R5 fails. Example 1-24 shows the path taken between R5 and R2 when the Frame Relay
interface is shut down on R5. To break the peering without using ACLs, you simply need to ensure that the ebgp-multihop count used in the original peering is set at 2 and no greater. Example 1-24 also shows the ICMP debug with the TTL expiration messages that indicate the peering has failed even though IP connectivity exists between loopbacks. If you have your ebgp-multihop count set at 2 between R2 and R5, you have scored 2 points.

Example 1-24  eBGP TTL Expiration

R5(config)# int s0/0/1
R5(config-if)# shut

R5# trace 120.100.2.1

Type escape sequence to abort.
Tracing the route to 120.100.2.1

1 120.100.45.4 0 msec 0 msec 0 msec
2 120.100.34.3 0 msec 4 msec 0 msec
3 120.100.123.2 4 msec * 4 msec

R5# debug ip icmp
ICMP packet debugging is on
R5#
*Jan 17 21:32:32.455: ICMP: time exceeded rcvd from 120.100.34.3
R5#
*Jan 17 21:32:32.179: ICMP: time exceeded rcvd from 120.100.34.3
R5#

R2# debug ip icmp
ICMP packet debugging is on
Example 1-24  eBGP TTL Expiration  continued

R2#
Jan 17 21:26:11.310: ICMP: time exceeded rcvd from 120.100.34.4
R2#
Jan 17 21:26:13.306: ICMP: time exceeded rcvd from 120.100.34.4

- Configure a new loopback interface 2 on R2 of 130.100.200.1/24 and advertise this into BGP using the network command. Configure R2 in such a way that if the Frame Relay connection between R2 and R5 fails, AS300 no longer receives this route. Do not use any filtering between neighbors or neighbor-specific commands to achieve this. (3 points)

If the peering fails between R2 and R5, instead of flowing directly from AS100 to AS300, the new network route flows from AS100 to AS300 via AS200. As such, communities can be used to ensure that the route is not exported to AS200. You simply need to apply a no-export value to the route as it is advertised on R2 toward R3. This way the route is not advertised to AS200 in the event of a failure. Under normal conditions AS200 would still see the route from AS300. If you have configured this correctly, as shown in Example 1-25, you have scored 3 points.

Example 1-25  Route Advertisement and no-export Configuration on R2

R5# sh ip bgp
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>130.100.200.0/24</td>
<td>120.100.4.1</td>
<td>0</td>
<td>100</td>
<td>200</td>
<td>10 i</td>
</tr>
</tbody>
</table>

R2(config)# interface Loopback2
R2(config-if)# ip address 130.100.200.1 255.255.255.0
R2(config-if)# router bgp 10
R2(config-router)# network 130.100.200.0 mask 255.255.255.0
Example 1-25  Route Advertisement and no-export Configuration on R2  

R2(config-router)# neighbor 120.100.3.1 route-map NO-EXPORT out
R2(config-router)# neighbor 120.100.3.1 send-community
R2(config-router)# exit
R2(config)# access-list 5 permit 130.100.200.0
R2(config)# route-map NO-EXPORT permit 10
R2(config-route-map)# match ip address 5
R2(config-route-map)# set community no-export
R2(config-route-map)# route-map NO-EXPORT permit 20

R3# sh ip bgp 130.100.200.1
BGP routing table entry for 130.100.200.0/24, version 4
Paths: (1 available, best #1, table Default-IP-Routing-Table, not advertised to EGP peer)
  Advertised to update-groups:
      2
  Local, (Received from a RR-client)
      120.100.2.1 (metric 65) from 120.100.2.1 (130.100.200.1)
       Origin IGP, metric 0, localpref 100, valid, internal, best
       Community: no-export

R5# conf t
Enter configuration commands, one per line.  End with CNTL/Z.
R5(config)# int s0/0/1
R5(config-if)# shut
R5(config-if)# ^Z
R5# show ip bgp

R5#
Configure Hot Standby Router Protocol (HSRP) between R5 and R6 on VLAN300 with R5 the active for .1/24. If the network 130.100.200.0/24 is no longer visible to AS300, R6 should dynamically become the HSRP active. Configure R5 to achieve this solution. (4 points)

The clue is in the question. All you need to do is track the specific route with the IP SLA object-tracking feature and inform the HSRP process if the BGP route is withdrawn. You might feel that this isn’t strictly a BGP question, but because the IOS section has been removed from the exam, topics and features like this crop up within other sections. So, it’s best to be aware of as many features as possible. Because the question doesn’t specifically instruct you to configure an exact IP address for your HSRP, you are free to use an unallocated IP address.

R5 should be the HSRP active under normal conditions, so this should be configured with the preempt command to reinstate control when the route becomes visible once again post withdrawal. Similarly, R6 also requires preempt to take control when the priority of R5 decrements. R5 hasn’t been configured with a priority in this example because it uses the default value of 100. Example 1-26 shows the configuration and testing steps involved to withdraw the route by shutting down the Frame Relay interface on R5 and toggle the HSRP functionality between R5 and R6. If you have configured this correctly, as shown in Example 1-26, you have scored 4 points.

Example 1-26   IP SLA Tracking and HSRP Configuration on R5 and R6

```plaintext
R5(config)# track 2 ip route 130.100.200.0 255.255.255.0 reachability
R5(config-track)# interface GigabitEthernet0/1
R5(config-if)# standby 1 ip 150.100.3.1
R5(config-if)# standby 1 preempt
R5(config-if)# standby 1 track 2 decrement 20

R6(config)# interface GigabitEthernet0/1
R6(config-if)# standby 1 ip 150.100.3.1
```
Example 1-26  IP SLA Tracking and HSRP Configuration on R5 and R6  continued

R6(config-if)# standby 1 priority 90
R6(config-if)# standby 1 preempt

R5# sh standby gigabitEthernet 0/1
GigabitEthernet0/1 - Group 1
  State is Active
    23 state changes, last state change 00:20:11
  Virtual IP address is 150.100.3.1
  Active virtual MAC address is 0000.0c07.ac01
    Local virtual MAC address is 0000.0c07.ac01 (v1 default)
  Hello time 3 sec, hold time 10 sec
  Next hello sent in 0.460 secs
  Preemption enabled
  Active router is local
  Standby router is 150.100.3.6, priority 90 (expires in 8.472 sec)
  Priority 100 (default 100)

  Track object 2 state Up decrement 20
    IP redundancy name is 'hsrp-Gi0/1-1' (default)

R5#
R5# conf t
R5(config)# int s0/0/1
R5(config-if)# shut
R5(config-if)#
Example 1-26  IP SLA Tracking and HSRP Configuration on R5 and R6  continued

R5#bgp-3-notification: sent to neighbor 120.100.2.1 4/0 (hold time expired) 0 bytes
R5#hsrp-6-statechange: GigabitEthernet0/1 Grp 1 state Active -> Standby
R5#hsrp-6-statechange: GigabitEthernet0/1 Grp 1 state Standby -> Active
R5#sh standby gigabitEthernet 0/1
GigabitEthernet0/1 - Group 1

State is Standby

- 25 state changes, last state change 00:00:10
- Virtual IP address is 150.100.3.1
- Active virtual MAC address is 0000.0c07.ac01
- Local virtual MAC address is 0000.0c07.ac01 (v1 default)
- Hello time 3 sec, hold time 10 sec
- Next hello sent in 1.800 secs
- Preemption enabled

Active router is 150.100.3.6, priority 90 (expires in 8.980 sec)
Standby router is local
Priority 80 (default 100)

Track object 2 state Down decrement 20
IP redundancy name is 'hsrp-Gi0/1-1' (default)

- Configure two new loopback interfaces on R1 and R2 of 126.1.1.1/24 and 130.1.1.1/24, respectively, and advertise these into BGP using the network command. R3 should be configured to allow only BGP routes originated from R1 up to network 128.0.0.0 and from above network 128.0.0.0 only those originated from R2. Use only a single ACL on R3 as part of your solution. (3 points)
This is an intricate question because you are permitted to use only a single ACL to filter the routes on R3. The method to achieve this is to use an ACL that matches networks up to 128.0.0.0 and permit this through one route map while denying through a separate route map. The route maps should be applied on a per-neighbor basis, and both call up the same single ACL. Example 1-27 shows the configuration for the new loopbacks on R1 and R2 and the filtering on R3. Further testing is detailed in Example 1-28 to substantiate the filtering process on R3. If you have configured this correctly, as shown in Example 1-27, you have scored 3 points.

**Example 1-27  Route Map Filtering on R3**

```
R1(config)# interface Loopback1
R1(config-if)# ip address 126.1.1.1 255.255.255.0
R1(config-if)# router bgp 10
R1(config-router)# network 126.1.1.0 mask 255.255.255.0

R2(config)# interface Loopback1
R2(config-if)# ip address 130.1.1.1 255.255.255.0
R2(config-if)# router bgp 10
R2(config-router)# network 130.1.1.0 mask 255.255.255.0

R3(config)# access-list 1 permit 0.0.0.0 127.255.255.255
R3(config)# route-map UPT0128 permit 10
R3(config-route-map)# match ip add 1

R3(config)# route-map ABOVE128 permit 10
R3(config-route-map)# match ip add 1
R3(config-route-map)# route-map ABOVE128 permit 20
```
Example 1-27  Route Map Filtering on R3  continued

R3(config)# router bgp 10
R3(config-router)# neighbor 120.100.1.1 route-map UPT0128 in
R3(config-router)# neighbor 120.100.2.1 route-map ABOVE128 in

R3# sh ip bgp
BGP table version is 8, local router ID is 120.100.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*i126.1.1.0/24</td>
<td>120.100.1.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>*i130.1.1.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>*i130.100.200.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
</tbody>
</table>

R3#

Further testing of the filtering requires additional interfaces to be configured and advertised on R1 and R2. Example 1-28 shows an interface higher than 128.0.0.0 advertised on R1 and one lower advertised on R2. R3 simply blocks these from entering BGP.

Example 1-28  Route Map Filtering Verification

R1(config)# interface Loopback3
R1(config-if)# ip address 132.1.1.1 255.255.255.0
R1(config-if)# router bgp 10
R1(config-router)# network 132.1.1.0 mask 255.255.255.0
R1(config-router)# \Z
Example 1-28  Route Map Filtering Verification  continued

R1# show ip bgp neighbors 120.100.3.1 advertised
BGP table version is 7, local router ID is 126.1.1.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>126.1.1.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td>32768</td>
<td></td>
<td>i</td>
</tr>
<tr>
<td>132.1.1.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td>32768</td>
<td></td>
<td>i</td>
</tr>
</tbody>
</table>

Total number of prefixes 2

R3# show ip bgp
BGP table version is 4, local router ID 120.100.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>126.1.1.0/24</td>
<td>120.100.1.1</td>
<td>0</td>
<td>100</td>
<td></td>
<td>i</td>
</tr>
<tr>
<td>130.1.1.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>100</td>
<td></td>
<td>i</td>
</tr>
<tr>
<td>130.100.200.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>100</td>
<td></td>
<td>i</td>
</tr>
</tbody>
</table>

R2# configure
R2(config)# interface Loopback3
R2(config-if)# ip address 100.1.1.1 255.255.255.0
Example 1-28  Route Map Filtering Verification  continued

R2(config-if)# router bgp 10
R2(config-router)# network 100.1.0.0 mask 255.255.255.0
R2(config-router)# ^Z
R2# sh ip bgp neighbor 120.100.3.1 advertised
BGP table version is 5, local router ID is 130.100.200.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*&gt; 100.1.1.0/24</td>
<td></td>
<td>0.0.0.0</td>
<td></td>
<td>32768</td>
<td>i</td>
</tr>
<tr>
<td>*&gt; 130.1.0.0/24</td>
<td></td>
<td>0.0.0.0</td>
<td></td>
<td>32768</td>
<td>i</td>
</tr>
<tr>
<td>*&gt; 130.100.200.0/24</td>
<td></td>
<td>0.0.0.0</td>
<td></td>
<td>32768</td>
<td>i</td>
</tr>
</tbody>
</table>

Total number of prefixes 3

R3# sh ip bgp
BGP table version is 4, local router ID is 120.100.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*&gt;126.1.1.0/24</td>
<td>120.100.1.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>*&gt;130.1.1.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>*&gt;130.100.200.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
</tbody>
</table>
Section 4: IPv6 (14 Points)

The prerequisite to the questions is configuration of the IPv6 addresses and Frame Relay. You should test your IPv6 connectivity to ensure that you are ready to progress to the routing questions. Of course, you need Frame Relay maps to achieve connectivity. In contrast to IPv4 though, you need two maps: one to reach the IPv6 remote address over the PVC and one to map to the remote link local addresses. Example 1-29 shows the initial testing over Frame Relay and required IPv6 configuration to progress onto the routing questions. Consider using the show ipv6 interfaces brief command for a quick check of your interface configuration.

Example 1-29 IPv6 Testing and Initial Configuration

R1# debug frame-relay packet
Frame Relay packet debugging is on
R1# ping ipv6 2007:C15:C0:11::3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2007:C15:C0:11::3, timeout is 2 seconds:

Serial0/0/0: Encapsulation IPv6 failed--no map entry link 70(IPV6)

R1# conf t
R1(config)# int s0/0/0
R1(config-if)# frame-relay map ipv6 2007:C15:C0:11::3 103 broadcast
R1(config-if)# ^Z
R1#

R3# conf t
R3(config)# int s0/0/0
R3(config-if)# frame-relay map ipv6 2007:C15:C0:11::1 301 broadcast
R3(config-if)# ^Z
Example 1-29  IPv6 Testing and Initial Configuration  continued

R1# ping ipv6 2007::C15::C0:11::3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2007::C15::C0:11::3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/4/4 ms
R1#

R3# sh ipv6 int s0/0/0 | include link-local
   IPv6 is enabled, link-local address is FE80::214:6AFF:FEFC:7300
   No Virtual link-local address(es):
R3#

R1# sh ipv6 interface s0/0/0 | include link-local
   IPv6 is enabled, link-local address is FE80::213:3FF::FEB:E3C0
   No Virtual link-local address(es):
R1#

R2# sh ipv6 interface s0/0 | include link-local
   IPv6 is enabled, link-local address is FE80::213:7FF::FEB4:BEE0
   No Virtual link-local address(es):
R2#
Example 1-29   IPv6 Testing and Initial Configuration  

RS\# sh ipv6 interface s0/0/1 | include link-local

IPv6 is enabled, link-local address is FE80::214:6AFF:FEFC:F130
No Virtual link-local address(es):
RS#

R1(config)# ipv6 unicast-routing
R1(config)# interface gigabitEthernet 0/1
R1(config-if)# ipv6 address 2007:C15:C0:10::1/64
R1(config-if)# interface Serial0/0/0
R1(config-if)# ipv6 address 2007:C15:C0:11::1/64
R1(config-if)# frame-relay map ipv6 2007:C15:C0:11::3 103 broadcast
R1(config-if)# frame-relay map ipv6 2007:C15:C0:11::2 103 broadcast
R1(config-if)# frame-relay map ipv6 FE80::213:7FFF:FE84:BE60 103 broadcast
R1(config-if)# frame-relay map ipv6 FE80::214:6AFF:FEFC:7390 103 broadcast

R2(config)# ipv6 unicast-routing
R2(config)# interface fastEthernet 0/1
R2(config-if)# ipv6 address 2007:C15:C0:12::2/64
R2(config-if)# interface serial 0/0
R2(config-if)# ipv6 address 2007:C15:C0:11::2/64
R2(config-if)# frame-relay map ipv6 2007:C15:C0:11::1 203 broadcast
R2(config-if)# frame-relay map ipv6 2007:C15:C0:11::3 203 broadcast
R2(config-if)# frame-relay map ipv6 2007:C15:C0:10::12 203 broadcast
R2(config-if)# frame-relay map ipv6 FE80::213:C3FF:FE7B:E3C1 203 broadcast
Example 1-29  IPv6 Testing and Initial Configuration  continued

R2(config-if)# frame-relay map ipv6 FE80::214:6AFF:FEFC:7390 203 broadcast
R2(config-if)# interface serial 0/1
R2(config-if)# ipv6 address 2007:C15:C0:14::2/64
R2(config-if)# frame-relay map ipv6 FE80::214:6AFF:FEFC:F130 215 broadcast
R2(config-if)# frame-relay map ipv6 2007:C15:C0:14::5 215 broadcast

R3(config)# ipv6 unicast-routing
R3(config)# interface gigabitEthernet 0/0
R3(config-if)# ipv6 address 2007:C15:C0:15::3/64
R3(config-if)# interface serial 0/0/0
R3(config-if)# ipv6 address 2007:C15:C0:11::3/64
R3(config-if)# frame-relay map ipv6 2007:C15:C0:11::1 301 broadcast
R3(config-if)# frame-relay map ipv6 2007:C15:C0:11::2 302 broadcast

R4(config)# ipv6 unicast-routing
R4(config)# interface gigabitEthernet 0/0
R4(config-if)# ipv6 address 2007:C15:C0:15::4/64

R5(config)# ipv6 unicast-routing
R5(config)# interface gigabitEthernet 0/1
R5(config)# ipv6 address 2007:C15:C0:16::5/64
R5(config-if)# interface Serial10/0/1
R5(config-if)# ipv6 address 2007:C15:C0:14::5/64
R5(config-if)# frame-relay map ipv6 2007:C15:C0:14::2 512 broadcast
R5(config-if)# frame-relay map ipv6 FE80::213:7FFF:FE84:BEE0 512 broadcast
Example 1-29  IPv6 Testing and Initial Configuration

```
R6(config)# ipv6 unicast-routing
R6(config)# interface gigabitEthernet 0/1
R6(config-if)# ipv6 address 2001:0:0:0:16::6/64
```

Section 4.1: RIPng

- Configure Routing Information Protocol next generation (RIPng) ensuring that your IPv6 routes are visible throughout your RIPng domain. Do not disable split-horizon. (3 points)

By default, R3 has split-horizon enabled on the Frame Relay interface. The hub receives both R1 and R2 Ethernet associated IPv6 routes, but because split-horizon does not advertise, these back out onto the same interface. Because you are not permitted to disable split-horizon, you need to create a tunnel between R1 and R2. Example 1-30 shows the initial RIPng configuration and routing tables of R1 and R2 without each other’s Ethernet IPv6 routes present and the required tunnel configuration. If you have configured this correctly, as shown in Example 1-30, you have scored 3 points.

Example 1-30  RIPng Configuration and Testing

```
R1(config)# interface gigabitEthernet 0/1
R1(config-if)# ipv6 rip CCIE enable
R1(config-if)# interface Serial0/0/0
R1(config-if)# ipv6 rip CCIE enable
```
Example 1-30  RIPng Configuration and Testing  continued

R2(config)# interface fastEthernet 0/1
R2(config-if)# ipv6 rip CCIE enable
R2(config-if)# interface serial 0/0
R2(config-if)# ipv6 rip CCIE enable
R2(config-if)# interface serial 0/1
R2(config-if)# ipv6 rip CCIE enable

R3(config)# interface gigabitEthernet 0/0
R3(config-if)# ipv6 rip CCIE enable
R3(config-if)# interface serial 0/0/0
R3(config-if)# ipv6 rip CCIE enable

R4(config)# interface gigabitEthernet 0/0
R4(config-if)# ipv6 rip CCIE enable

R5(config)# interface Serial0/0/1
R5(config-if)# ipv6 rip CCIE enable

R1# show ipv6 route rip
IPv6 Routing Table - 10 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
    U - Per-user Static route
    I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
    0 - OSPF intra, O1 - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
    O1N - OSPF NSSA ext 1, O2N - OSPF NSSA ext 2
    D - EIGRP, EX - EIGRP external
R  207:0C16:0C0:15::/64 [120/2]
    via FE80::214:6AFF:FEFC:7300, Serial0/0/0

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Example 1-30  RIPng Configuration and Testing  continued

R2# show ipv6 route rip
IPv6 Routing Table - 10 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
      U - Per-user Static route
      I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
      0 - OSPF intra, 0I - OSPF inter, 0E1 - OSPF ext 1, 0E2 - OSPF ext 2
      ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
      D - EIGRP, EX - EIGRP external
R  2007:C15:C0:15::/64 [120/2]
   via FE80::214:6AFF:FEFC:7390, Serial0/0

R3# show ipv6 route rip
IPv6 Routing Table - 10 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
      U - Per-user Static route
      I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
      0 - OSPF intra, 0I - OSPF inter, 0E1 - OSPF ext 1, 0E2 - OSPF ext 2
      ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
      D - EIGRP, EX - EIGRP external
R  2007:C15:C0:10::/64 [120/2]
   via FE80::213:C3FF:FE7B:E3C0, Serial0/0/0
R  2007:C15:C0:12::/64 [120/2]
   via FE80::213:7FFF:FE84:BEE0, Serial0/0/0

R1(config)# interface Tunnel1
R1(config-if)# ipv6 address 2007:C15:C0:13::1/64
Example 1-30  RIPng Configuration and Testing  

R1(config-if)# ipv6 rip CCIE enable
R1(config-if)# tunnel source Serial0/0/0
R1(config-if)# tunnel destination 120.100.123.2
R1(config-if)# tunnel mode ipv6ip

R2(config)# interface Tunnel1
R2(config-if)# ipv6 address 2007:C15:C0:13::2/64
R2(config-if)# ipv6 rip CCIE enable
R2(config-if)# tunnel source Serial0/0
R2(config-if)# tunnel destination 120.100.123.1
R2(config-if)# tunnel mode ipv6ip

R1# show ipv6 route rip
IPv6 Routing Table - 11 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
U - Per-user Static route
I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
OS - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
D - EIGRP, EX - EIGRP external

R  2007:C15:C0:12::/64 [120/2]
   via FE80::7B54:7B02, Tunnel1
R  2007:C15:C0:14::/64 [120/2]
   via FE80::7B54:7B02, Tunnel1
R  2007:C15:C0:15::/64 [120/2]
   via FE80::214:6AFF:FEFC:7390, Serial0/0/0
Example 1-30  RIPng Configuration and Testing  continued

R2# show ipv6 route rip
IPv6 Routing Table - 13 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       U - Per-user Static route
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       O - OSPF intra, 01 - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
       D - EIGRP, EX - EIGRP external
R  2007:C15:0:10::/64 [120/2]
   via FE80::7884:7B01, Tunnel1
R  2007:C15:0:15::/64 [120/2]
   via FE80::214:8AFF:FEFC:7390, Serial0/0

Section 4.2: OSPFv3

Configure OSPFv3 with a process ID of 1 and with all OSPF interfaces assigned to area 0. (2 points)

This is a clear-cut OSPFv3 configuration. If you have configured this correctly, as shown in Example 1-31, you have scored 2 points.

Example 1-31  R5 and R6 OSPFv3 Configuration

R6(config)# interface gigabitEthernet 0/1
R5(config-if)# ipv6 ospf 1 area 0

R6(config)# interface gigabitEthernet 0/1
R6(config-if)# ipv6 ospf 1 area 0

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Example 1-31  R5 and R6 OSPFv3 Configuration

R5# show ipv6 ospf neighbor

<table>
<thead>
<tr>
<th>Neighbor ID</th>
<th>Pri</th>
<th>State</th>
<th>Dead Time</th>
<th>Interface ID</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>120.100.6.1</td>
<td>1</td>
<td>FULL/DR</td>
<td>00:00:30</td>
<td>3</td>
<td>GigabitEthernet0/1</td>
</tr>
</tbody>
</table>

R6# show ipv6 ospf neighbor

<table>
<thead>
<tr>
<th>Neighbor ID</th>
<th>Pri</th>
<th>State</th>
<th>Dead Time</th>
<th>Interface ID</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>120.100.5.1</td>
<td>1</td>
<td>FULL/BDR</td>
<td>00:00:39</td>
<td>3</td>
<td>GigabitEthernet0/1</td>
</tr>
</tbody>
</table>

- The IPv6 network is deemed to be stable. As such, reduce the number of link-state advertisements (LSA) flooded within the OSPF domain. (2 points)

To suppress the unnecessary flooding of link-state advertisements in stable topologies, the `ipv6 ospf flood-reduction` command is required under interface configuration mode. If you have configured this correctly, as shown in Example 1-32, you have scored 2 points.

Example 1-32  R5 and R6 Flood-Reduction Configuration

R5(config)# interface gigabitEthernet 0/1
R5(config-if)# ipv6 ospf flood-reduction

R6(config)# interface gigabitEthernet 0/1
R6(config-if)# ipv6 ospf flood-reduction
Section 4.3: Redistribution

- Distribute RIPng routes into the OSPFv3 domain (one way). RIP routes should have a fixed cost of 5000 associated to them within the OSPF network. (1 point)

As per vanilla OSPF, the default behavior for OSPFv3 is to redistribute routes to be advertised with a fixed cost as type 2 external routes, so a simple redistribution configuration with a default metric of 5000 on R5 is required. Example 1-33 shows the required configuration and routing table on R6 for the redistributed RIPng routes. Pay attention to ensure that you have full route visibility because the Frame Relay network on R5 (2007::C15::C0:14::) is not present within the OSPFv3 domain unless R5 specifically redistributes its own connected interfaces. If you have configured this correctly, as shown in Example 1-33, you have scored 1 point.

Example 1-33  R5 OSPFv3 Redistribution Configuration

```
R5(config)# ipv6 router ospf 1
R5(config-router)# redistribute rip CCIE metric 5000

R6# sh ipv6 route ospf
IPv6 Routing Table - 10 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       U - Per-user Static route
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       O1N1 - OSPF NSSA ext 1, O2N2 - OSPF NSSA ext 2
       D - EIGRP, EX - EIGRP external
O2E  2007::C15::10::/64  [110/5000]  (100/5000)
    via F80::214::AFF:FEFC:F13f, GigabitEthernet0/1
O2E  2007::C15::11::/64  [110/5000]  (100/5000)
    via F80::214::AFF:FEFC:F13f, GigabitEthernet0/1
```
Example 1-33  R5 OSPFv3 Redistribution Configuration  continued

```
0E2  2007:C15:0:12::/64 [110/5000]
    via FE80::214:6AFF:FEFC:Fi31, GigabitEthernet0/1
0E2  2007:C15:0:13::/64 [110/5000]
    via FE80::214:6AFF:FEFC:Fi31, GigabitEthernet0/1
0E2  2007:C15:0:15::/64 [110/5000]
    via FE80::214:6AFF:FEFC:Fi31, GigabitEthernet0/1
```

R5(config)# ipv6 route ospf 1
R5(config-rtr)# redistribute rip CCIE metric 5000 include-connected

R6# show ipv6 route 2007:C15:0:14::
IPv6 Routing Table - 10 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
    U - Per-user Static route
    I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
    D - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
    ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
    D - EIGRP, EX - EIGRP external

```
0E2  2007:C15:0:14::/64 [110/5000]
    via FE80::214:6AFF:FEFC:Fi31, GigabitEthernet0/1
```

- Ensure that the OSPFv3 network is reachable from the RIP network by a single route of 2007::/16, which should be seen within the RIP domain. Configure R5 only to achieve this. The OSPF domain should continue to receive specific RIPng subnets. (2 points)

Because you are not mutually redistributing protocols, you are required to configure an IPv6 summary route into the RIPng domain on R5 to provide full connectivity from the RIPng domain into OSPFv3. If you have configured this correctly, as shown in Example 1-34, you have scored 2 points.
Example 1-34  R5 RIPng Summary Configuration and Connectivity Testing

R5(config-if)# int s0/0/1
R5(config-if)# ipv6 rip CCIE summary-address 2007::/16

R1# show ipv6 route rip
IPv6 Routing Table - 13 entries
R 2007::/16 [120/3]
   via FE80::213:7FFF:FE84:BEE0, Tunnel1
R 2007:C15:C0:12::/64 [120/2]
   via FE80::213:7FFF:FE84:BEE0, Tunnel1
R 2007:C15:C0:14::/64 [120/2]
   via FE80::213:7FFF:FE84:BEE0, Tunnel1
R 2007:C15:C0:15::/64 [120/2]
   via FE80::214:6AFF:FEFC:7390, Serial0/0/0

R1#
R1# ping ipv6 2007:C15:C0:16::5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2007:C15:C0:16::5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/12/16 ms

R1# ping ipv6 2007:C15:C0:16::6

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2007:C15:C0:16::6, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/15/16 ms
If the serial link fails between the OSPF and RIPng domains, ensure that routing is still possible between R5 and R4 over VLAN45. Do not enable RIP on the VLAN45 interfaces of R4 and R5. Configure R4 and R5 to achieve this, and this should be considered an alternative path only in the event of a failure. (3 points)

R4 and R5 both belong to the RIPng domain. If you can’t enable RIPng on the VLAN45 interfaces, all you can do is create a tunnel between the devices. You might have considered enabling OSPFv3 between routers, but you have not been given sufficient information to perform this. Also, it would then create additional problems in terms of redistribution points.

Example 1-35 shows the required configuration to tunnel IPv6 through IPv4 on R4 and R5. Notice that certain routes have a lower hop count through the tunnel as opposed to through the physical RIPng network. The question states that the newly configured link should be used only in the event of a failure. As such, you must penalize the tunnel by use of an offset-list applied directly to the tunnel interface of R4 and R5. R5 still receives the summary /16 route configured earlier via the tunnel, regardless of how high you set the hop count. The following question addresses this condition. If you have configured this correctly, as shown in Example 1-35, you have scored 3 points.

**Example 1-35  R4 and R5 Tunnel Configuration and Verification**

R4(config)# interface Tunnel0
R4(config-if)# ipv6 address 2007:C15:C0:17::4/64
R4(config-if)# ipv6 rip CCIE enable
R4(config-if)# tunnel source GigabitEthernet0/1.45
R4(config-if)# tunnel destination 120.100.45.5
R4(config-if)# tunnel mode ipv6ip

R5(config)# interface Tunnel0
R5(config-if)# ipv6 address 2007:C15:C0:17::5/64
R5(config-if)# ipv6 rip CCIE enable
R5(config-if)# tunnel source GigabitEthernet0/0
R5(config-if)# tunnel destination 120.100.45.4
R5(config-if)# tunnel mode ipv6ip
Example 1-35  R4 and R5 Tunnel Configuration and Verification  continued

R4# show ipv6 route rip
IPv6 Routing Table - 12 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
U - Per-user Static route
I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
O - OSPF intra, OI - OSPF inter, OEL - OSPF ext 1, OEL2 - OSPF ext 2
ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
D - EIGRP, EX - EIGRP external

R 2007::/16 [120/4]
  via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0

R 2007::C0:10::/64 [120/3]
  via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0

R 2007::C0:11::/64 [120/2]
  via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0

R 2007::C0:12::/64 [120/3]
  via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
  via FE80::7864:2D05, Tunnel0

R 2007::C0:13::/64 [120/3]
  via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
  via FE80::7864:2D05, Tunnel0

R 2007::C0:14::/64 [120/2]
  via FE80::7864:2D05, Tunnel0
Example 1-35  R4 and R5 Tunnel Configuration and Verification  

R5# show ipv6 route rip
IPv6 Routing Table - 14 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
     U - Per-user Static route
     I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
     O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
     ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
     D - EIGRP, EX - EIGRP external

R 2007::/16 [120/5]  
    via FE80::7864:2D04, Tunnel0
R 2007:C15:C0:10::/64 [120/3]  
    via FE80::213:7FFF:FE84:BE00, Serial0/0/1
R 2007:C15:C0:11::/64 [120/2]  
    via FE80::213:7FFF:FE84:BE00, Serial0/0/1
R 2007:C15:C0:12::/64 [120/2]  
    via FE80::213:7FFF:FE84:BE00, Serial0/0/1
R 2007:C15:C0:13::/64 [120/2]  
    via FE80::213:7FFF:FE84:BE00, Serial0/0/1
R 2007:C15:C0:15::/64 [120/2]  
    via FE80::7864:2D04, Tunnel0

R5(config)# interface Tunnel0
R5(config-if)# ipv6 rip CCIE metric-offset 4
R5(config-if)# do show ipv6 route rip
IPv6 Routing Table - 14 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
     U - Per-user Static route
     I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
Example 1-35  R4 and R5 Tunnel Configuration and Verification  continued

- OSPF intra, 0I - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
- ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
- D - EIGRP, EX - EIGRP external

R 2007::/16 [120/8]
  via FE80::7864:2D04, Tunnel0

R 2007:C15:0:10::64 [120/3]
  via FE80::213:7FFF:FE84:BEE0, Serial0/0/1

R 2007:C15:0:11::64 [120/2]
  via FE80::213:7FFF:FE84:BEE0, Serial0/0/1

R 2007:C15:0:12::64 [120/2]
  via FE80::213:7FFF:FE84:BEE0, Serial0/0/1

R 2007:C15:0:13::64 [120/2]
  via FE80::213:7FFF:FE84:BEE0, Serial0/0/1

R 2007:C15:0:14::64 [120/3]
  via FE80::213:7FFF:FE84:BEE0, Serial0/0/1

R4(config)# interface Tunnel0
R4(config-if)# ipv6 rip CCIE metric-offset 4
R4(config-if)# do show ipv6 route rip

IPv6 Routing Table - 12 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
  U - Per-user Static route
  I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
  0 - OSPF intra, 0I - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
  ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
  D - EIGRP, EX - EIGRP external

R 2007::/16 [120/4]
Example 1-35  R4 and R5 Tunnel Configuration and Verification  

<table>
<thead>
<tr>
<th>R</th>
<th>2007:C15:0:0:10::64 [120/3]</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>2007:C15:0:0:11::64 [120/2]</td>
</tr>
<tr>
<td>R</td>
<td>2007:C15:0:0:12::64 [120/3]</td>
</tr>
<tr>
<td>R</td>
<td>2007:C15:0:0:13::64 [120/3]</td>
</tr>
<tr>
<td>R</td>
<td>2007:C15:0:0:14::64 [120/3]</td>
</tr>
</tbody>
</table>

Ensure that the summary route configured previously is not seen back on the routing table of R5. Configure only R5 to achieve this. (1 point)

As briefly discussed in the previous question, the summary route returns to R5 through the newly created tunnel interface. This is expected behavior because of the method in which it was originally advertised. A simple prefix-list is required on R5 to deny the summary and permit all other routes entering the tunnel interface. If you have configured this correctly, as shown in Example 1-36, you have scored 3 points.

Example 1-36  R5 Distribute-List Configuration and Verification

```
R5# show ipv6 route rip
IPv6 Routing Table - 14 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
U - Per-user Static route
I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
```
Example 1-36  R5 Distribute-List Configuration and Verification  continued

```
0 - OSPF intra, 01 - OSPF inter, 0E1 - OSPF ext 1, 0E2 - OSPF ext 2
OEH - OSPF NSSA ext 1, 0N2 - OSPF NSSA ext 2
D - EIGRP, EX - EIGRP external

R 2007::/16 [120/8]
   via FE80::7864:2D04, Tunnel0

R 2007:C16:0:10::/64 [120/3]
   via FE80::213:7FF:FE84:BEE0, Serial0/0/1

R 2007:C15:0:11::/64 [120/2]
   via FE80::213:7FF:FE84:BEE0, Serial0/0/1

R 2007:C15:0:12::/64 [120/2]
   via FE80::213:7FF:FE84:BEE0, Serial0/0/1

R 2007:C15:0:13::/64 [120/2]
   via FE80::213:7FF:FE84:BEE0, Serial0/0/1

R 2007:C15:0:15::/64 [120/3]
   via FE80::213:7FF:FE84:BEE0, Serial0/0/1
```

R5(config)# ipv6 prefix-list BLOCK-SUMMARY seq 10 deny 2007::/16
R5(config)# ipv6 prefix-list BLOCK-SUMMARY seq 15 permit ::/0 le 128
R5(config)# ipv6 router rip CCIE
R5(config-router)# distribute-list prefix-list BLOCK-SUMMARY in Tunnel0
R5(config-router)# do show ipv6 route rip
IPv6 Routing Table - 13 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
   U - Per-user Static route
   I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
0 - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
OEH - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
Example 1-36  R5 Distribute-List Configuration and Verification  continued

D  -  EIGRP,  EX  -  EIGRP external

R  2007:C15:C0:10::/64  [120/3]
via  FE0::213:7FF:FE84:BEE0, Serial0/0/1

R  2007:C15:C0:11::/64  [120/2]
via  FE0::213:7FF:FE84:BEE0, Serial0/0/1

R  2007:C16:C0:12::/64  [120/2]
via  FE0::213:7FF:FE84:BEE0, Serial0/0/1

R  2007:C15:C0:13::/64  [120/2]
via  FE0::213:7FF:FE84:BEE0, Serial0/0/1

R  2007:C15:C0:14::/64  [120/3]
via  FE0::213:7FF:FE84:BEE0, Serial0/0/1

Section 5: QoS (8 Points)

- You are required to configure quality of service (QoS) on switch 1 according to the Cisco QoS baseline model. Create a Modular QoS configuration that facilitates the following requirements for all user ports (Fast Ethernet 1–24) (3 points):

  1. All ports should trust the DSCP values received from their connecting devices.

  2. Packets received from the user ports with Differentiated Services Code Point (DSCP) values of 10, 16, 24, 28, 32, 34, 46, and 48 should be remarked to DSCP 8 (PHB CS1) in the event of traffic flowing above 5 Mbps on a per-port basis. This traffic could be a combination of any of the earlier DSCP values with any source/destination combination. Ensure that a minimum burst value is configured above the 5 Mbps.
It is acknowledged within the industry that a user port rarely generates more than 5 Mbps of traffic on a standard FastEthernet connection. If traffic rates increase above this threshold, it could be indicative of a DoS or worm attack. A method of mitigating an attack is to create a “Scavenger-Class” that simply re-marks traffic DSCP values after the threshold has been exceeded. This does not block traffic, but does ensure that mission-critical traffic remains unaffected from an attack by trusting the DSCP value for known traffic and re-marking unknown application traffic down to CS1.

To answer the question, you are required to create a Modular QoS policy that trusts the incoming DSCP value received from the host within the policy rather than by configuring the trust value on a per-interface basis and by policing traffic at a rate of 5 Mbps. When the minimum burst rate is exceeded, the DSCP values are remapped according to the policed-dscp map to Scavenger-Class CS1 (DSCP8). Note that all DSCP baseline values are being remapped with the exception of DSCP26, which is generally reserved for mission-critical data. This approach allows traffic associated with this value to remain unchanged even when traffic rates exceed 5 Mbps. This approach also assumes that the virus does not itself re-mark traffic to this value to increase its chances of causing damage.

The exclusion of DSCP26, though, is not relevant to the configuration and methodology you use to answer the question. The question requires that you configure a standard IP ACL that permits any traffic. For traffic matching this classification, the DSCP value in the incoming packet is trusted. If the matched traffic exceeds an average traffic rate of 5 Mbps and a normal burst size of 8000 bytes, its DSCP is marked down according to the policed DSCP map values and transmitted. If you have configured this correctly, as shown in Example 1-37, you have scored 3 points.

Example 1-37  QoS Configuration and Verification

```plaintext
SW1(config)# mls qos
SW1(config)# mls qos map policed-dscp 48 46 34 32 24 28 16 10 to 8
SW1(config)# access-list 1 permit any
SW1(config)# class-map POLICE
SW1(config-cmap)# match access-group 1
SW1(config-cmap)# exit
```
Example 1-37  QoS Configuration and Verification  continued

SW1(config)# policy-map RE-MARK
SW1(config-pmap)# class POLICE
SW1(config-pmap-c)# trust dscp
SW1(config-pmap-c)# police 5000000 8000 exceed-action policed-dscp-transmit
SW1(config-pmap-c)# exit
SW1(config-pmap)# exit
SW1(config)# interface range fastEthernet 0/1-24
SW1(config-if-range)# service-policy input RE-MARK

SW1# show policy-map RE-MARK
  Policy Map RE-MARK
  Class POLICE
    police 5000000 8000 exceed-action policed-dscp-transmit
    trust dscp

Switch 1 will be connected to a new trusted domain in the future using interface gigabit 0/1. A DSCP value of AF43 received locally on sw1 should be mapped to AF42 when destined for the new domain. (2 points)

This requires a DSCP mutation map to convert DSCP values between environments. If you don’t realize that AF43 is DSCP38 and AF42 is DSCP36, you struggle to answer this question, but a search of your documentation CD can assist you. For the mutation map to function correctly, you must explicitly trust DSCP values received on the interface on which you are configuring the map. If you have configured this correctly, as shown in Example 1-38, you have scored 2 points.
Example 1-38  Switch 1 DSCP Mutation Map Configuration

```
SW1(config)# mls qos map dscp-mutation AF43-T0-AF42 38 to 36
SW1(config)# interface Gig0/1
SW1(config-if)# mls qos trust dscp
SW1(config-if)# mls qos dscp-mutation AF43-T0-AF42
```

Configure Cisco Modular QoS into classes as follows on R1 for the following traffic types based on their associated per hop behavior. Incorporate these into an overall policy that should be applied to the T1 interface S0/0/0. Assume a permanent virtual circuit (PVC) of line rate on the Frame Relay network and allow each class the effective bandwidth as detailed (3 points).

<table>
<thead>
<tr>
<th>Class</th>
<th>PHB</th>
<th>Assigned Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routing</td>
<td>CS6</td>
<td>46 kbps</td>
</tr>
<tr>
<td>VoIP</td>
<td>EF</td>
<td>247 kbps</td>
</tr>
<tr>
<td>Interactive Video</td>
<td>AF41</td>
<td>247 kbps</td>
</tr>
<tr>
<td>Mission Critical Data</td>
<td>AF31</td>
<td>247 kbps</td>
</tr>
<tr>
<td>Call-Signaling</td>
<td>CS3</td>
<td>46 kbps</td>
</tr>
<tr>
<td>Transactional Data</td>
<td>AF21</td>
<td>216 kbps</td>
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<tr>
<td>Network-mgmt</td>
<td>CS2</td>
<td>46 kbps</td>
</tr>
<tr>
<td>Bulk Data</td>
<td>AF11</td>
<td>46 kbps</td>
</tr>
<tr>
<td>Scavenger</td>
<td>CS1</td>
<td>15 kbps</td>
</tr>
<tr>
<td>Default</td>
<td>0</td>
<td>386 kbps</td>
</tr>
</tbody>
</table>
Heaps of points are offered here, so you know it’s either going to be complex or involve a great deal of configuration. In fact, this one is a bit of both, so you run a risk of configuration errors for those points to slip away. Also some math is involved because the policy-map requires a percentage value of bandwidth as opposed to actual speed. Because you are using a T1 interface, you know that the maximum available bandwidth is 1544 kbps and a line rate PVC is assumed, so the values required are as follows: 1 percent = 15 kbps, 3 percent = 46 kbps, 14 percent = 216 kbps, 16 percent = 247 kbps, 25 percent = 386 kbps.

A class-map to match all values for the provided classes is required, which is then associated with the policy-map. The overall policy is then applied to the outgoing interface Serial0/0/0, and a nice little “gotcha” is that you must configure the interface with the command max-reserved-bandwidth 100; otherwise, the full bandwidth is not made available for the policy. Usually you would assign voice traffic into a real-time queue (Low Latency Queuing [LLQ]), but the question doesn’t dictate this. So, effectively all traffic types are being assigned with different proportions of Class-Based Weighted Fair Queuing (CBWFQ). If you have configured this correctly, as shown in Example 1-39, you have scored 3 points.

dm

Example 1-39 Switch 1 Modular QoS Configuration

```
R1# sh run class-map
!
class-map match-all VOIP
  match ip dscp ef
class-map match-all BULK-DATA
  match ip dscp af1
class-map match-all NET-MAN
  match ip dscp cs2
class-map match-all VIDEO
  match ip dscp af4
class-map match-all ROUTING
  match ip dscp cs6
```

Example 1-39  Switch 1 Modular QoS Configuration  continued

```
class-map match-all SCAVENGER
   match ip dscp cs1
class-map match-all TRANS-DATA
   match ip dscp af21
class-map match-all MISSION-CRIT
   match ip dscp af31
class-map match-all CALL-SIG
   match ip dscp cs3
!
end
```

R1# sh run policy-map
!
policy-map QOS
   class VOIP
      bandwidth percent 16
   class VIDEO
      bandwidth percent 16
   class BULK-DATA
      bandwidth percent 3
      random-detect
   class TRANS-DATA
      bandwidth percent 14
   class NET-WAN
      bandwidth percent 3
   class ROUTING
      bandwidth percent 3
```
Example 1-39  Switch 1 Modular QoS Configuration  

```plaintext
class SCAVENGER
    bandwidth percent 1
class MISSION-CRIT
    bandwidth percent 16
    random-detect
class CALL-SIG
    bandwidth percent 3
class class-default
    bandwidth percent 25

Rf# sh run int s0/0/0 | begin max-reserved-bandwidth 100
    max-reserved-bandwidth 100
    service-policy output QOS
end

Rf# show policy-map QOS
Policy Map QOS
    Class VOIP
        Bandwidth 16 (%) Max Threshold 64 (packets)
    Class VIDEO
        Bandwidth 16 (%) Max Threshold 64 (packets)
    Class BULK-DATA
        Bandwidth 3 (%) exponential weight 9
        class min-threshold max-threshold mark-probability
```

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Example 1-39  Switch 1 Modular QoS Configuration  continued

<p>| | | | | | | | |</p>
<table>
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<tr>
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</tr>
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</table>

Class TRANS-DATA
  Bandwidth 14 (%) Max Threshold 64 (packets)
Class NET-WAN
  Bandwidth 3 (%) Max Threshold 64 (packets)
Class ROUTING
  Bandwidth 3 (%) Max Threshold 64 (packets)
Class SCAVENGER
  Bandwidth 1 (%) Max Threshold 64 (packets)
Class MISSION-CRIT
  Bandwidth 16 (%)
    exponential weight 9

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<th>class</th>
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<td>Switch 1 Modular QoS Configuration</td>
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<tr>
<td>rsvp</td>
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</table>

Class `CALL-SIG`
- Bandwidth 3 (%) Max Threshold 64 (packets)

Class `class-default`
- Bandwidth 25 (%)

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<td>6</td>
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<tr>
<td>7</td>
</tr>
<tr>
<td>rsvp</td>
</tr>
</tbody>
</table>
Section 6: Security (8 Points)

- Configure R3 to identify and discard the following custom virus. The virus is characterized by the ASCII characters "Hastings_Beer" within the payload and utilizes User Datagram Protocol (UDP) ports 11664 to 11666. The ID of the virus begins on the third character of the payload. The virus originated on VLAN 34. (4 points)

This fictitious virus requires the use of NBAR with Packet Description Language Module (PDLM) to inspect a packet's payload to identify the virus based on the information supplied within the question. Because the virus is located within the third ASCII character, you must inform the custom NBAR list to ignore the first two characters, which ensures that it begins to check the third packet. If you have configured this correctly, as shown in Example 1-40, you have scored 3 points. You can use the show policy-map command to verify your configuration.

Example 1-40  R3 NBAR Configuration

```
R3(config)# ip nbar custom Hastings_Beer 2 ascii Hastings_Beer udp range 11664 11666
R3(config)# class-map match-all VIRUS
R3(config-cmap)# match protocol Hastings_Beer
R3(config-cmap)# policy-map BLOCK-VIRUS
R3(config-pmap)# class VIRUS
R3(config-pmap-c)# drop
R3(config-pmap-c)# interface gigabit0/0
R3(config-if)# Service-policy input BLOCK-VIRUS
```

- An infected host is on VLAN 200 of 150.100.2.100. Ensure that only within BGP AS10, traffic destined for this host is directed to Null0 of each local router. You cannot use any ACLs to block traffic to this host specifically, but can use a static route pointing to Null0 for traffic destined to 192.0.2.0 /24 on routers within AS10. R2 can have an additional static route pointing to Null0. Use a BGP feature on R2 to ensure that traffic to this source is blocked. Prevent unnecessary replies when traffic is passed to the Null0 interface for users residing on VLAN100. (4 points)
This question is representative of Black Hole routing and is an effective method of discarding packets being sent to a known destination. This approach to discarding traffic is efficient because it allows the edge routers to route traffic rather than using ACLs, and it can be deployed dynamically by making use of the next hop field within BGP updates. You are permitted to create a static route on routers R1, R2, and R3 in AS10 for network 192.0.2.0/24 to Null0 and one additional route on R2. This route needs to be directing traffic to the infected host to Null0.

To update routers R1 and R3, R2 simply advertises the host route for the infected host to AS10 and sets the next-hop for this to 192.0.2.1. Routers R1 and R3 then direct traffic to Null0 when traffic is destined to the infected host. To ensure that the solution is used only in AS10 you must set the community to no-export for the specific static route. Also, tagging the route with a value of 10 identifies it. You must therefore send the community values to neighbor R3 on R2, which you should have completed previously for an earlier BGP question. Use of the no icmp unreachable command on R1’s GigabitEthernet interface prevents unnecessary replies when traffic is passed to the Null0 interface. If you have configured this correctly, as shown in Example 1-41, you have scored 3 points.

**Example 1-41  BGP Black Hole Routing Configuration and Verification**

```
R2(config)# ip route 192.0.2.1 255.255.255.255 Null0
R2(config)# ip route 150.100.2.1 255.255.255.255 Null0 Tag 10
R2(config)# router bgp 10
R2(config-router)# redistribute static route-map BLACKHOLE
R2(config-router)# route-map BLACKHOLE permit 10
R2(config-route-map)# match tag 10
R2(config-route-map)# set ip next-hop 192.0.2.1
R2(config-route-map)# set community no-export
R2(config-route-map)# exit
R2(config)# ip route 192.0.2.1 255.255.255.255 Null0
R2(config)# do show ip bgp neigh 120.100.3.1 advertised
BGP table version is 6, local router ID is 130.100.200.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
```
Example 1-41  BGP Black Hole Routing Configuration and Verification  

Total number of prefixes 3

R2# show ip route 150.100.2.100
Routing entry for 150.100.2.100/32
Known via 'static', distance 1, metric 0 (connected)
Tag 10
Redistributing via bgp 10
Advertised by bgp 10 route-map BLACKHOLE
Routing Descriptor Blocks:
* directly connected, via Null0
Route metric is 0, traffic share count is 1
Route tag 10

R3(config)# ip route 192.0.2.1 255.255.255.255 Null0
R3(config)# do show ip bgp
BGP table version is 14, local router ID is 120.100.3.1
Status codes: s suppressd, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*&gt;126.1.1.0/24</td>
<td>120.100.1.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>*&gt;130.1.1.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>*&gt;130.100.200.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>* 150.100.2.100/32</td>
<td>192.0.2.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
</tbody>
</table>
Example 1-41  BGP Black Hole Routing Configuration and Verification  continued

R1(config)# ip route 192.0.2.1 255.255.255.255 Null0
R1(config)# interface Gigabit0/1
R1(config-if)# no icmp unreachable
R1(config-if)# do show ip bgp
BGP table version is 8, local router ID is 126.1.1.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal, r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*&gt; 126.1.1.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td></td>
<td>32768</td>
<td>i</td>
</tr>
<tr>
<td>*&gt;1130.1.1.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>*&gt;1130.100.200.0/24 120.100.2.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>* 150.100.2.100/32 192.0.2.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
<td></td>
</tr>
</tbody>
</table>

R1# show ip route 150.100.2.100
Routing entry for 150.100.2.100/32
Known via 'bgp 10', distance 200, metric 0, type internal
Last update from 192.0.2.1 00:00:02 ago
Routing Descriptor Blocks:
* 192.0.2.1, from 120.100.3.1, 00:00:02 ago
Route metric is 0, traffic share count is 1
AS Hops 0
R1# show ip route 192.0.2.1
Routing entry for 192.0.2.1/32
Known via 'static', distance 1, metric 0 (connected)
Routing Descriptor Blocks:
* directly connected, via Null0
Route metric is 0, traffic share count is 1
Section 7: Multicast (6 Points)

- Configure routers R1, R2, R3, and R4 for IPv4 Multicast. Configure R3 to send multicast advertisements of its own time by use of Network Time Protocol (NTP) sourced from interface Gig 0/0. Configure Protocol Independent Multicast (PIM) sparse mode on all required interfaces. R3 should also be used to advertise its own Gigabit interface IP address as a rendezvous point (RP). R3 should also advertise the IP address you are using for the NTP advertisements, which is to be 224.0.1.1. Do not use the command ntp server in any configurations. Routers R1, R2, and R4 should all show a clock synchronized to that of R3. (5 points)

NTP can be multicast on the reserved group IP address of 224.0.1.1 rather than in the more familiar broadcast or unicast scenarios. The question requires you to configure R3 to become the ntp master and announce the group address to the NTP clients. Because you are not permitted to use the command ntp server, you must configure the clients with the command ntp multicast client. They then have the capability to join the NTP group by use of PIM. It is good practice to TTL scope your multicast announcements so that they do not propagate past the domain you require. If you haven’t taken this into consideration in your solution, you are not deducted points, but be aware of the facility in case you are met with a question that specifies this. If you have configured this correctly, as shown in Example 1-42, you have scored 6 points.

Example 1-42    NTP Multicast Configuration and Verification

```plaintext
R3(config)# ip multicast-routing
R3(config)# ntp master
R3(config)# interface GigabitEthernet0/0
R3(config-if)# ip pim sparse-node
R3(config-if)# ntp multicast ttl 2
R3(config-if)# interface Serial0/0/0
R3(config-if)# ip pim sparse-node
R3(config-if)# ip pim send-rp-announce GigabitEthernet0/0 scope 2 group-list 4
R3(config)# ip pim send-rp-discovery GigabitEthernet0/0 scope 2
R3(config)# access-list 4 permit 224.0.1.1
```
Example 1-42  NTP Multicast Configuration and Verification  continued

R3# show ntp status
Clock is synchronized, stratum 8, reference is 127.127.7.1
nominal freq is 250.0000 Hz, actual freq is 250.0000 Hz, precision is 2**18
reference time is C08F1E81.2AE19310 (21:17:21.167 UTC Tue Feb 27 2007)
clock offset is 0.0000 msec, root delay is 0.00 msec
root dispersion is 0.02 msec, peer dispersion is 0.02 msec

R1(config)# ip multicast-routing
R1(config-if)# interface Serial0/0/0
R1(config-if)# ip pim sparse-mode
R1(config-if)# ntp multicast client

R1# show ntp status
Clock is synchronized, stratum 9, reference is 120.100.34.3
nominal freq is 250.0000 Hz, actual freq is 250.0000 Hz, precision is 2**18
reference time is C08F1E79.9FB2321D (21:17:45.623 UTC Tue Feb 27 2007)
clock offset is 0.0157 msec, root delay is 3.88 msec
root dispersion is 0.06 msec, peer dispersion is 0.02 msec
R1(config-if)#
R1# show ip igmp group
IGMP Connected Group Membership
Group Address  Interface          Uptime    Expires    Last Reporter
224.0.1.1     Serial0/0/0        00:40:12  00:02:50  120.100.123.1
224.0.1.30    Serial0/0/0        00:07:21  00:02:51  120.100.123.3
224.0.1.40    Serial0/0/0        00:40:13  00:02:52  120.100.123.1

R2(config)# ip multicast-routing
R2(config-if)# interface Serial0/0
Example 1-42  NTP Multicast Configuration and Verification  continued

R2(config-if)# ip pim sparse-mode
R2(config-if)# ntp multicast client

R2# show ntp status
Clock is synchronized, stratum 9, reference is 120.100.34.3
nominal freq is 250.0000 Hz, actual freq is 250.0000 Hz, precision is 2**18
reference time is C08F1E73.83B73E68 (21:17:39.514 UTC Tue Feb 27 2007)
clock offset is 0.0182 msec, root delay is 4.14 msec
root dispersion is 15875.06 msec, peer dispersion is 15875.02 msec
R2# show ip igmp group
IGMP Connected Group Membership

<table>
<thead>
<tr>
<th>Group Address</th>
<th>Interface</th>
<th>Uptime</th>
<th>Expires</th>
<th>Last Reporter</th>
</tr>
</thead>
<tbody>
<tr>
<td>224.0.1.1</td>
<td>Serial0/0</td>
<td>00:41:08</td>
<td>00:02:59</td>
<td>120.100.123.2</td>
</tr>
<tr>
<td>224.0.1.39</td>
<td>Serial0/0</td>
<td>00:00:12</td>
<td>00:02:57</td>
<td>120.100.123.3</td>
</tr>
<tr>
<td>224.0.1.40</td>
<td>Serial0/0</td>
<td>00:41:09</td>
<td>00:01:59</td>
<td>120.100.123.2</td>
</tr>
</tbody>
</table>

R4(config)# ip multicast-routing
R4(config-if)# interface GigabitEthernet0/0
R4(config-if)# ip pim sparse-mode
R4(config-if)# ntp multicast client

R4# show ntp status
Clock is synchronized, stratum 9, reference is 120.100.34.3
nominal freq is 250.0000 Hz, actual freq is 250.0000 Hz, precision is 2**18
reference time is C08F1EF1.2B7DBF2 (21:19:45.169 UTC Tue Feb 27 2007)
clock offset is -0.8937 msec, root delay is 1.37 msec
Example 1-42  NTP Multicast Configuration and Verification  continued

root dispersion is 7877.00 msec, peer dispersion is 7876.34 msec

R4# show ip igmp group

<table>
<thead>
<tr>
<th>IGMP Connected Group Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group Address</td>
</tr>
<tr>
<td>224.0.1.1</td>
</tr>
<tr>
<td>224.0.1.39</td>
</tr>
<tr>
<td>224.0.1.40</td>
</tr>
</tbody>
</table>

Lab Wrap-Up

So, how did it go? Did you run out of time? Did you manage to finish but miss what was actually required? If you scored over 80, well done. If you accomplished this within the time frame, go book your lab! What sets the CCIE exam apart within the industry is the complexity of the questions to test you further than you thought possible. The exam isn’t trying to trip you up, but it ensures that you have the ability to think laterally, an ability that ensures you succeed in your networking career and one that sets CCIEs apart. Spend the time to go back over the questions and practice with the configurations using debug and show commands to fully absorb any new areas you might have come across.

Did you anticipate and factor into your configuration items such as the offset list within RIPng for the tunnel and maximum reserved bandwidth within QoS? If you did, then congratulations because this saved you time and secured your points. It also shows that you fully understand the protocols involved and can adapt in testing your configurations. How can you ensure that you have the ability to spot any underlying issues related to a question? Well, it’s all mileage; you get out of your study what you put into it.
Practice Lab

Aim to adhere to the time limit of 8 hours on this lab on the initial runthrough. Then either score yourself at this point or continue until you feel you have met all the objectives. You now are going to be guided through the equipment requirements and prelab tasks in preparation for taking this practice lab.

This lab was created using the official Cisco online CCIE R&S Assessor, version B topology. Detailed information on the Assessor can be found on the following URL:


If you don’t own six routers and four switches, the Assessor lab can be used for this lab by loading the initial files supplied for this chapter in Appendix B.

Equipment List

You need the following hardware and software components to commence this practice lab:

- Six routers loaded with Cisco IOS Software Release 12.4 Advanced Enterprise image and the minimum interface configuration as documented in Table 2-1.

<table>
<thead>
<tr>
<th>Table 2-1</th>
<th>Hardware Required per Router</th>
</tr>
</thead>
<tbody>
<tr>
<td>Router</td>
<td>Model</td>
</tr>
<tr>
<td>R1</td>
<td>3825</td>
</tr>
<tr>
<td>R2</td>
<td>3725</td>
</tr>
<tr>
<td>R3</td>
<td>3825</td>
</tr>
<tr>
<td>R4</td>
<td>3825</td>
</tr>
<tr>
<td>R5</td>
<td>3825</td>
</tr>
<tr>
<td>R6</td>
<td>3825</td>
</tr>
</tbody>
</table>

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One 3550 switch with Cisco IOS Software release 12.2 IP Services and three 3560 switches with Cisco IOS Software release 12.2 Advanced IP Services.

Setting Up the Lab

Feel free to use any combination of routers as long as you fulfill the requirements within the topology diagram as shown in Figure 2-1. However, it is recommended that you use the same model of routers because this makes life easier if you load configurations directly from the supplied configurations into your own devices.

Access Configuration Appendixes Online

Log in at www.ciscopress.com/account to gain access to copy/paste enabled versions of the configuration files contained in the appendixes. A link to the content will be listed on your Account page under Registered Products.

Lab Topology

This practice lab uses the topology as outlined in Figure 2-1, which you must re-create with your own equipment or by simply using the CCIE Assessor.
NOTE
Notice in the initial configurations supplied that some interfaces do not have an IP address preconfigured. This is because you either do not use that interface or you need to configure this interface from default within the exercise. The initial configurations supplied should be used to preconfigure your routers and switches before the lab starts.

If your routers have different interface speeds than those used within this book, adjust the bandwidth statements on the relevant interfaces to keep all interface speeds in line. This ensures that you do not get unwanted behavior because of differing Interior Gateway Protocol (IGP) metrics.
Switch Instructions

Configure virtual LAN (VLAN) assignments from the configurations supplied or from Table 2-2.

<table>
<thead>
<tr>
<th>VLAN</th>
<th>Switch 1</th>
<th>Switch 2</th>
<th>Switch 3</th>
<th>Switch 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>Fa0/3, Fa0/4, Fa0/5</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>46</td>
<td>Fa0/6</td>
<td>Fa0/4</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>53</td>
<td>VLAN53</td>
<td>Fa0/5</td>
<td>VLAN53</td>
<td>—</td>
</tr>
<tr>
<td>63</td>
<td>—</td>
<td>Fa0/6</td>
<td>VLAN63</td>
<td>VLAN63</td>
</tr>
<tr>
<td>100</td>
<td>—</td>
<td>Fa0/1</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>200</td>
<td>—</td>
<td>Fa0/2</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Connect your switches with RJ-45 Ethernet crossover cables, as shown in Figure 2-2.
Frame Relay Instructions

Configure one of the routers you are going to use in the lab as a Frame Relay switch, or have a dedicated router purely for this task. This lab uses a dedicated router within the CCIE Assessor version B topology for the Frame Relay switch. A fully meshed environment is configured between all the Frame Relay routers. Pay attention in the lab as to which permanent virtual circuits (PVC) are actually required. Keep the encapsulation and Local Management Interface (LMI) settings to default for this exercise, but experiment with the settings outside the labs to enhance your Frame Relay knowledge.

If you are using your own equipment, keep the data circuit-terminating equipment (DCE) cables at the frame switch end for simplicity and provide a clock rate to all links from this end.
After configuration, the Frame Relay connectivity represents the logical Frame Relay network, as shown in Figure 2-3.

**IP Address Instructions**

In the real CCIE lab, you find that the majority of your IP addresses are preconfigured. For this exercise you are required to configure your IP addresses as shown in Figure 2-4, or load the initial router configurations supplied in Appendix B. If you are manually configuring your equipment, be sure you include the following loopback addresses (R1 and R3 use the same IP address for loopback 255):

- R1 Lo0 120.100.1.1/24
  - Lo255 200.200.200.200/24
- R2 Lo0 120.100.2.1/24
- R3 Lo0 120.100.3.1/24
  - Lo255 200.200.200.200/24
R4 Lo0 120.100.4.1/24
R5 Lo0 120.100.5.1/24
R6 Lo0 120.100.6.1/24
SW1 Lo0 120.100.7.1/24
SW2 Lo0 120.100.8.1/24
SW3 Lo0 120.100.9.1/24
SW4 Lo0 120.100.10.1/24

FIGURE 2-4
IP Addressing Diagram
Prelab Tasks

- Build the lab topology as per Figure 2-1 and Figure 2-2.
- Configure your Frame Relay switch router to provide the necessary data-link connection identifiers (DLCI) as per Figure 2-3.
- Configure the IP addresses on each router as shown in Figure 2-4 and add the loopback addresses. Alternatively, you can load the initial configuration files supplied in Appendix B if your router is compatible with those used to create this exercise.

General Guidelines

- Please read the whole lab before you start.
- Do not configure any static/default routes unless otherwise specified.
- Use only the DLCIs provided in the appropriate figures.
- Ensure full IP visibility between routers for ping testing/Telnet access to your devices.
- If you find yourself running out of time, choose questions that you are confident you can answer. Failing this, choose questions with a higher point rating to maximize your potential score.
- Get into a comfortable and quiet environment where you can focus for the next 8 hours.
- Take a 30-minute break midway through the exercise.
- Have available a Cisco Documentation CD-ROM, or access online the latest documentation from the following URL:
  www.cisco.com/univercd/home/home.htm
Practice Lab 2

You will now be answering questions in relation to the network topology as shown in Figure 2-5.
Section 1: LAN Switching and Frame Relay (24 Points)

- Configure your switched network to use 802.1w spanning tree. Switch 1 should be the root bridge for VLANs 34, 46, 53, 63, 100, and 200 with switch 2 being the secondary root bridge for all listed VLANs. (3 points)

- Switch 3 should use its interface directly connecting to switch 2 (Fast Ethernet 0/21) for traffic directed toward even-numbered VLANs (34, 46, 100, 200) and the interface directly connecting to switch 1 (Fast Ethernet 0/19) for odd-numbered VLANs (53, 63). (3 points)

- Switch 4 should use its interface directly connecting to switch 2 (Fast Ethernet 0/19) for traffic destined toward even-numbered VLANs (34, 46, 100, 200) and the interface directly connected to Switch 1 (Fast Ethernet 0/21) for odd-numbered VLANs (53, 63). (3 points)

- Ensure a cable fault between switches 1 and 2 does not result in one-way traffic between the two switches resulting in spanning-tree issues. (2 points)

- Configure switch 1 and switch 2 to allow connectivity of two more switches in the future to be connected into ports Fast Ethernet 0/18 on each switch. The new switches should be able to tunnel their own configured VLANs through a new VLAN (30) between switch 1 and switch 2. You have no requirement to configure a root bridge or VLAN load balancing for the new VLAN between switch 1 and switch 2. (4 points)

- Configure your switched network to monitor the VLAN200 interface associated with R2 (switch 2 Fast Ethernet 0/1), and send only traffic destined to R2 on this switch port across your network to switch 3 port Fast Ethernet 0/17. Use a new VLAN (20) to assist in this configuration. You have no requirement to configure a root bridge or VLAN load balancing for the new VLAN. (3 points)

- Configure the interface on switch 2 that connects to R5 VLAN53 (Fast Ethernet 0/5) in such a way that if all the trunks on switch 2 connecting to switch 1, switch 3, and switch 4 should fail, this Ethernet port transitions into error-disable state. (4 points)
Your initial Frame Relay configuration has been supplied for the R1-R2-R3 connectivity. Configure Frame Relay as per Figure 2-6 to ensure that each device is reachable over the Frame Relay network. Only use the indicated DLCIs. (2 points)

Section 2: IPv4 IGP Protocols (28 Points)
You will now be answering questions in relation to EIGRP, OSPF, RIPv2, and redistribution between these protocols.

Section 2.1: EIGRP
- Configure Enhanced Interior Gateway Routing Protocol (EIGRP) as per Figure 2-7 using an AS of 1. Each EIGRP router should have its loopback 0 interface configured and advertised within EIGRP. (2 points)
- Configure R1 to advertise a summary route of 120.100.0.0/16 outbound on its serial interface. R3 should see the original VLAN100 and loopback 0 individual routes in addition to the summary route. You can use only one summary route in your configuration. (3 points)

- Ensure that the length of time that EIGRP considers neighbors to be valid without receiving a hello packet on the Frame Relay network between R1, R2, and R3 is 200 seconds. Do not change the hello-interval parameter. (2 points)
Configure new loopback interfaces on R1 and R2 using a loopback interface 2 with an identical IP address of 150.101.1.1/24 on both routers. Advertise this network into EIGRP on each router. Ensure that R3 prefers the route from R2 by manipulating the delay associated with this route. Do not manually adjust the delay associated with the interface by use of the `delay` command. You are permitted to configure only R2 to influence the delay. (3 points)
Configure Open Shortest Path First (OSPF) as per Figure 2-8 using a process ID of 1. Where possible, all OSPF configurations should not be configured under the process ID. Each OSPF router should also have its loopback 0 interface configured and advertised within OSPF as follows: (2 points)

- R4 Loopback 0 - Area 0
- R5 Loopback 0 - Area 0
- R6 Loopback 0 - Area 1
- Sw1 Loopback 0 - Area 2
- Sw2 Loopback 0 - Area 1
- Sw3 Loopback 0 - Area 2
- Sw4 Loopback 0 - Area 3

Area 0 is partitioned between R4 and R5. Ensure that your network can accommodate this issue. You are not permitted to form any area 0 neighbor relationship directly between R4 and R5 to join area 0. (4 points)

Section 2.3: RIPv2

Configure RIPv2 between R2 and R3 per Figure 2-9. Configure a new loopback interface on R2 (loopback 3) with an IP address of 150.101.2.1/24. Advertise this and only this network to R3 from R2. (2 points)
R3 should not advertise any connected interfaces into Routing Information Protocol version 2 (RIPv2). Do not filter routing advertisements to achieve this behavior. (2 points)

Section 2.4: Redistribution
- Perform a one-way redistribution of RIPv2 into EIGRP on R3 using the following default metric: 1544 20000 255 1 1500. Ensure that R1 shows a next hop for the RIPv2 advertised route of 150.101.2.0/24 of R2. Perform configuration only on R3 for this task. (3 points)
- Perform mutual redistribution of EIGRP and OSPF on R4 and R5. Use a metric of 5000 for redistributed routes into OSPF, which should appear as external type 2 routes, and the following K values for OSPF routes redistributed into EIGRP: 1544 20000 255 1 1500. (2 points)
- R3 will have equal cost external EIGRP routes to the redistributed OSPF subnet 120.100.63.0/24 (VLAN63). Configure only R3 to ensure that R3 routes via a next hop of R5 (120.100.34.5) for this destination subnet. If this route fails, the route advertised from R4 (120.100.34.4) should be used dynamically. (3 points)

**Section 3: BGP (15 Points)**

![BGP Topology Diagram]
Configure Border Gateway Protocol (BGP) peering as per Figure 2-10 as follows: Internal Border Gateway Protocol (iBGP) R1-R3, R2-R3, R4-R6, R4-SW2, R5-Sw1, R5-Sw3; External Border Gateway Protocol (eBGP) R3-R4, R3-R5, Sw4-Sw3, R6-Sw4. Use loopback interfaces to peer on all routers with the exception of peering between R3-R4 and R3-R5. Do not use the command `ebgp-multihop` within your configurations. (3 points)

Routers R1 and R2 in AS100 should be made to only passively accept BGP sessions. R3 should be configured to only actively create BGP sessions to R1 and R2 within AS100. (3 points)

Configure the following loopback interfaces on R3 and Sw4. Advertise these networks into BGP using the `network` command: (2 points)

- R3 - Loopback interface 5 (152.100.100.1/24)
- Sw4 - Loopback interface 5 (152.200.32.1/24)
- Sw4 - Loopback interface 6 (152.200.33.1/24)
- Sw4 - Loopback interface 7 (152.200.34.1/24)
- Sw4 - Loopback interface 8 (152.200.35.1/24)

Configure R3 to inform R4 that it does not want to receive routes advertised from Sw4 for networks 152.200.33.0/24, 152.200.34.0/24, and 152.200.35.0/24. Achieve this in such a manner that R4 does not actually advertise these routes toward R3. You can also configure R4. (4 points)

Configure a route map on R5 that prepends its local AS 2 an additional two times for network 152.200.32.0/24 when advertised to R3. The route map can contain multiple permit statements, but only one prepend is permitted per line. (3 points)
Section 4: IPv6 (12 Points)

- Configure IPv6 addresses on your network as follows:
  
  - 2007:C15:C0:10::1/64 - R1 Gi0/0
  - 2007:C15:C0:11::1/64 - R1 tunnel0
  - 2007:C15:C0:11::3/64 - R3 tunnel0
  - 2007:C15:C0:12::2/64 - R2 tunnel0
  - 2007:C15:C0:12::3/64 - R3 tunnel1
  - 2007:C15:C0:13::2/64 - R2 fe0/1
  - 2007:C15:C0:14::3/64 - R3 Gi0/0
  - 2007:C15:C0:14::4/64 - R4 Gi0/0
  - 2007:C15:C0:14::5/64 - R5 Gi0/0
  - 2007:C15:C0:15::5/64 - R4 Gi0/1
  - 2007:C15:C0:15::6/64 - R6 Gi0/0

Section 4.1: RIPng

- Configure Routing Information Protocol next generation (RIPng) among R1, R2, and R3 per Figure 2-11. RIPng should be enabled on the Ethernet interfaces of R1 and R2 and on all tunnel interfaces of R1, R2, and R3. Build your tunnels using ipv6ip mode; use an RIP process of CCIE on all required interfaces. (2 points)
Section 4.2: OSPFv3

- Configure OSPFv3 as per Figure 2-11; use an OSPFv3 process of 1 on each router. (2 points)

- Configure area 1 with IPsec authentication. Use message digest algorithm 5 (MD5), a Security Policy Index of 500, and a key of DEC0DECC1E0DDBA11B0BB0BBEDB00B00. (2 points)

- Ensure that the area router in area 1 receives the following route; you can configure R4 to achieve this. (2 points)
  - OI 2007::/16 [110/2]
  - via XXXX::XXXX:XXXX:XXXX:XXXX, GigabitEthernet0/0
Section 4.3: Redistribution

- Redistribute RIPng into OSPFv3 on R3. Redistributed RIPng routes should have a metric of 5000 associated with them regardless of which area they are seen in within the OSPFv3 network. (2 points)

- Configure R3 so that both R1 and R2 have the following IPv6 RIPng route in place. Do not redistribute OSPF into RIPng to achieve this and ensure that all routers have full visibility. (2 points)
  
  R 2007::/16 [120/2]
  
  via XXXX::XXXX:XXXX::XXXX:XXXX, Tunnel0

Section 5: QoS (6 Points)

- Two IP videoconferencing units are to be installed onto switch 2 ports FastEthernet 0/15 and 0/16 on VLAN200. The devices use TCP ports 3230–3231 and User Datagram Protocol (UDP) ports 3230–3235, and this traffic is unmarked from the devices as it enters the switch. Configure switch 2 to assign a Differentiated Services Code Point (DSCP) value of AF41 to video traffic from both of these devices. Ensure that the switch ports assigned to the devices do not participate in the usual spanning-tree checks, cannot form trunk links, and cannot be configured as EtherChannels. (3 points)

- Configure R2 to assign a strict priority queue with a 40 percent reservation of the WAN bandwidth for the videoconferencing traffic in the previous question. Maximize the available bandwidth by ensuring the real-time protocol (RTP) headers within the video stream are compressed. The remainder of the bandwidth should be guaranteed for a default queue with Weighted Random Early Detection (WRED) enabled. Assume that the full line rate of 1.544 Mbps is the available WAN bandwidth, and ensure that the complete bandwidth is utilized by both queues. (3 points)
Section 6: Multicast (7 Points)

- Configure routers R1, R2, R3, and R4 for IPv4 Multicast. Each router should use PIM sparse dense mode. Both R1 and R2 should be configured to be Candidate Rendezvous Points (RP) specifically for the multicast groups 225.225.0.1, 225.225.0.2, 225.225.0.3, and 225.225.0.4 by use of their loopback 0 interfaces. You should limit the boundary of your multicast network so that it does not propagate further into your network than R4. R3 should be configured as a mapping agent to announce the rendezvous points for the multicast network with the same boundary constraints. (3 points)

- Configure R3 to ensure R4 has a Candidate RP as R1 for groups 225.225.0.1 and 225.225.0.2 and R2 for groups 225.225.0.3 and 225.225.0.4. (2 points)

- Configure R1 to monitor traffic forwarded through itself for traffic destined to the multicast group of 225.225.0.1. If no packet for this group is received within a single 10-second interval, ensure that a Simple Network Management Protocol (SNMP) trap is sent to an SNMP management station on 120.100.100.100 using a community string of public. (2 points)

Section 7: Security (7 Points)

- Allow router R6 to passively watch the SYN connections that flow only to VLAN63 for servers that might reside on this subnet. To prevent a potential denial of service (DoS) attack from a flood of SYN requests, configure the router to randomly drop SYN packets from any source to this VLAN that have not been correctly established within 20 seconds. (3 points)

- Configure an access control list (ACL) on R1 to allow TCP sessions generated on this router and through its Ethernet interface and to block TCP sessions from entering on its Frame Relay interface that were not initiated on it or through it originally. Do not use the established feature within standard ACLs to achieve this, and apply ACLs only on the Frame Relay interface. The ACL should time out after 100 seconds of locally initiated TCP inactivity, and it should also allow Internet Control Message Protocol (ICMP) traffic inbound for testing purposes. (4 points)
“Ask the Proctor”

Section 1: LAN Switching and Frame Relay

Q: Do you just want me to configure the root and secondary root bridges into 802.1w spanning tree?

A: You should ensure that your network runs a consistent version of spanning tree.

Q: Can I change the root bridge assignments of odd- and even-numbered VLANs to ensure that different interfaces are used on switch 3 and switch 4?

A: No; the root bridge assignment should remain as per the first question.

Q: If a copper Ethernet cable fails between switch 1 and switch 2, would I encounter spanning-tree issues because no loops would be present under this condition?

A: Consider a partial failure rather than a complete breakage.

Q: But the switches are connected with Ethernet copper cables. A feature like Unidirectional Link Detection (UDLD) wouldn’t be beneficial unless the connections are fiber, would it?

A: UDLD can operate over copper Ethernet in the same manner as fiber.

Q: Would you like me to configure a native VLAN of 30 on trunks to the two new switches?

A: No, a native VLAN would not facilitate transportation of multiple VLANs over the single VLAN30 between switch 1 and switch 2.

Q: Are you looking for a generic routing encapsulation (GRE)–type tunnel between switches?

A: No; use a Layer 2 switch tunneling feature.
Q: I assume that you require remote span configured for R2 traffic. Is it okay to send both TX and RX traffic to switch 2?
A: Read the question carefully because this information has been provided.
Q: Would you like me to configure UDLD aggressive mode on switch 2 to transition the required port to error-disable mode in the event of a trunk failure?
A: No, you need to configure a feature that places a nontrunk link into error-disable mode if all the trunks on switch 2 fail.

Section 2: IPv4 IGP Protocols
You will now be answering questions in relation to EIGRP, OSPF, RIPv2, and redistribution between these protocols.

Section 2.1: EIGRP
Q: If I configure a summary-address on R1, this route overrides the VLAN100 and loopback 0 routes from R1 as received on R3. Is this correct?
A: Yes, this is the expected behavior of summarization. You must enable a feature that allows the more specific routes to be received on R3.
Q: I think I can achieve this with multiple summary routes, but the question restricts this. Can I use a new EIGRP process instead?
A: No, use a feature that allows your specific routes to leak from the summary route.
Q: Is it acceptable to adjust the hold-time on the Frame Relay interfaces to change the hello interval?
A: Yes.
Q: Can I manipulate the delay associated to network 150.101.1.0/24 because this advertisement leaves R2 rather than by changing an interface delay on R2?
A: Yes.
Section 2.2: OSPF

Q: I am experiencing neighbor adjacency issues between R5 and switch 1. Is this part of the question?
A: This is a byproduct of the question if you are using a 3550 in your topology. Practice your troubleshooting skills to determine what issues could be causing this behavior.

Q: I’ve checked my configs between R5 and switch 1, and they look good. Am I missing something from the initial configuration?
A: No; if your configuration is correct, you should debug your adjacencies to provide information on what could be causing an issue.

Q: I’ve found a maximum transmission unit (MTU) issue while debugging. Is it okay to change an interface MTU to fix this issue?
A: Yes.

Q: Is it acceptable to provide tunnels between R4 and R5 to join area 0?
A: No, this solution would involve a neighbor relationship being formed between the routers in area 0.

Q: I’d normally use a virtual link to extend area 0 into a transit area. Can I use this technique to stretch area 0 between R4 and R5?
A: You can use virtual links in your solution. Think about where the links need to be though, to ensure your topology operates correctly.

Section 2.3: RIPv2

Q: I’ve just checked the routing table of R3 to find that the only RIPv2 route received from R2 is the route required in the question. Am I good to move on, or have I missed something?
A: Read the question again. Even if you have only a single RIPv2 route in your routing table, it doesn’t mean it is the only RIPv2 route received by R3.
Q: Okay, I can see that I am still generating additional routes from R2 toward R3. Can I just block these with a distribute list on R3?
A: Yes.

Q: Can I just passive out the interfaces on R3 to make sure that they are not advertised to R2?
A: No, this would stop RIPv2 advertisements being sent out on these interfaces. It wouldn’t stop the actual interface subnets being advertised to R2.

Q: Can I create an offset list on R3 marking the attached networks on R3 as unreachable so that they are not advertised to R2?
A: No; look for a simple solution that blocks routing advertisements from leaving an interface.

Q: So I’m okay to use the passive-interface feature on the Frame Relay interface to stop advertising outbound but still okay to receive the specific route from R2 inbound?
A: Yes.

Section 2.4: Redistribution
Q: I’ve followed the redistribution instructions. Why don’t I receive the RIPv2 route on R1 after redistribution?
A: You are going to have some underlying issues prior to receiving the route on R1. Use your troubleshooting skills to determine the problem.

Q: I’ve noticed that because of the preconfigured loopback interfaces on R1 and R3 both of these routers have the same EIGRP router-id. Can I manually change the router-id on one of the routers to see whether this helps?
A: Yes.

Q: I’ve managed to get the RIPv2 route redistributed from R3 into EIGRP on R1, but the next hop is showing as R3. Can I policy route on R1 so that the next hop for this route is directly via R2?
A: No, you need to have the routing table reflect the next hop of this route via R2 and not R3.
Q: Can I use the EIGRP third-party next hop feature to leave the next hop of the route unaltered from R2?
A: Yes.

Q: Can I modify the OSPF cost on the interface connecting R3 to the OSPF network to attempt to change the next hop for the subnet 120.100.63.0/24?
A: No, this would affect routes received on R3 from both R4 and R5 equally because R4 and R5 reside on the same subnet as R3.

Q: Can I use an offset list or similar feature on R4 to penalize the route 120.100.63.0/24 as it advertises to R3?
A: No, you are permitted to configure only R3.

Q: Is it acceptable to use a route map on R3 and match a route source to penalize the route to 120.100.63.0/24?
A: Yes.

Section 3: BGP

Q: If I can’t use EBGP multihop on my peering on R6, switch 3 and switch 4, will my peering fail because I am peering from my loopback interfaces?
A: Yes, it will. You need to configure a feature that overrides this behavior.

Q: Can I try to use Network Address Translation (NAT) to fix my peering?
A: No, use a specific BGP feature to disregard the Time To Live (TTL) check.

Q: I’m experiencing peering issues between R1 and R3 and have BGP notifications displayed on the console. Is this expected behavior?
A: Yes, you had a similar issue within EIGRP. Check your router ID.

Q: Do you want me to configure an ACL to limit BGP connections to purely inbound or outbound on TCP port 179?
A: No, an ACL would actually break the peering entirely. Use a BGP feature to force the peering to become directional.

Q: Can I just configure a filter on R4 to stop advertising specific routes to R3?
A: No, you must dynamically inform R4 to not advertise specific routes via R3.

Q: Can I use BGP Outbound Route Filtering (ORF)?
A: Yes.

**Section 4: IPv6**

Q: Would you like me to configure an additional IPv6 subnet on R4 to receive the 2007:/16 route?
A: No, investigate an alternative method to create this route from the preconfigured subnets you already have, ensuring that the route is received as illustrated in the question.

Q: Would you like me to redistribute routes into OSPFv3 as external type 1 or type 2?
A: The question provides you with sufficient information to determine the redistribution type to use.

**Section 5: QoS**

Q: Do the virtual circuit (VC) units use User Datagram Protocol (UDP) ports 3230 and 3235 or 3230 through 3235?
A: They use the range 3230 through 3235.

Q: Do you want me to trust the ports assigned to the VC units?
A: The VC devices are not marking the traffic, so you do not need to trust these ports.
Q: Would you like me to disable trunking, channeling, and spanning-tree checks on the ports assigned to the VC units?
A: Yes, but remember that a single command can disable all these features.
Q: If I use the bandwidth percent command on R2 in my 40 percent guaranteed reservation, is this sufficient to answer the question?
A: No, the question dictates that a priority queue be used.
Q: Would you like me to configure RTP compression within a Frame Relay map-class?
A: No, you can achieve all the requirements within the same quality of service (QoS) policy map.

Section 6: Multicast

Q: If I configure R1 and R2 for the same multicast groups, won’t R3 and R4 see both routers as RPs for the same groups?
A: Yes, you address this behavior in the following question.
Q: To have R1 and R2 as Candidate RPs for different groups, can I just configure group-lists on R3?
A: If you were permitted to configure R1 and R2, group-lists would achieve the desired results, but you are permitted to configure only R3. Group-lists can assist in your solution on R3, but you need to find a method of assigning these specifically to R1 and R2.
Q: Do you want me to actually configure an Internet Group Management Protocol (IGMP) join-group on R1 for 225.225.0.1 for the SNMP question?
A: No, this isn’t required. Traffic destined to this group is sent to R1 regardless because it is the Candidate RP for this group.
Section 7: Security

Q: Do you want me to configure an ACL to block SYN packets coming into VLAN63?
A: No, SYN packets should still enter into VLAN63. You must configure a feature that monitors the SYN packets and closes down any half-opened connections.

Q: Can I use a reflexive ACL to drop SYN packets that are not correctly established by the servers?
A: No, a specific TCP feature is used to protect servers from a flood of SYN packets that could cause a DoS attack.

Q: Can I just use a standard ACL on R1 on the Frame Relay interface to permit sessions outbound and deny everything else inbound?
A: No, this would block return path traffic initiated by R1.

Q: Can I use a reflexive ACL to dynamically permit the return traffic with a time limit of 100 seconds?
A: Yes.
Lab Debrief

The lab debrief section now analyzes each question, showing you what was required and how to achieve the desired results. You should use this section to produce an overall score for this practice lab.

Section 1: LAN Switching and Frame Relay (24 Points)

- Configure your switched network to use 802.1w spanning tree. Switch 1 should be the root bridge for VLANs 34, 46, 53, 63, 100, and 200 with switch 2 being the secondary root bridge for all listed VLANs. (3 points)

802.1w is rapid spanning tree. The switches are going to be in the default mode of standard per-VLAN spanning tree (PVST) and require configuration to Rapid-PVST mode. Switch 1 is required to be the root bridge and switch 2 the secondary root bridge for VLANs 34, 46, 53, 63, 100, and 200. If you have configured this correctly, as shown in Example 2-1, you have earned 3 points. Example 2-1 also shows confirmation of the root bridge and which interfaces are used to reach the root bridge from the neighboring switches. VLAN34 is used as an example, but each VLAN would be identical in this configuration.

Example 2-1  Sw1, Sw2, Sw3, and Sw4 Configuration and Verification

```
Sw1(config)# spanning-tree mode rapid-pvst
Sw1(config)# spanning-tree vlan 34,46,53,63,100,200 root primary

Sw2(config)# spanning-tree mode rapid-pvst
Sw2(config)# spanning-tree vlan 34,46,53,63,100,200 root secondary
```
Example 2-1  Sw1, Sw2, Sw3, and Sw4 Configuration and Verification  

SW3(config)# spanning-tree mode rapid-pvst

SW4(config)# spanning-tree mode rapid-pvst

SW1# show spanning-tree vlan 34 | include root
   This bridge is the root
SW1# show spanning-tree vlan 46 | include root
   This bridge is the root
SW1# show spanning-tree vlan 53 | include root
   This bridge is the root
SW1# show spanning-tree vlan 63 | include root
   This bridge is the root
SW1# show spanning-tree vlan 100 | include root
   This bridge is the root
SW1# show spanning-tree vlan 200 | include root
   This bridge is the root

SW2# show spanning-tree vlan 34 | include Root FWD
Fa0/23       Root  FWD 19       128.25   P2p

SW3# show spanning-tree vlan 34 | include Root FWD
Fa0/19       Root  FWD 19       128.21   P2p

SW4# show spanning-tree vlan 34 | include Root FWD
Fa0/21       Root  FWD 19       128.23   P2p
Switch 3 should use its interface directly connecting to switch 2 (Fast Ethernet 0/21) for traffic directed toward even-numbered VLANs (34, 46, 100, 200) and the interface directly connecting to switch 1 (Fast Ethernet 0/19) for odd-numbered VLANs (53, 63). (3 points)

This is a straightforward VLAN load balancing question to ensure that trunk links are utilized efficiently and not logically disabled by spanning tree. Switch 3 uses the interface directly connecting to switch 1 (Fast Ethernet 0/19) for all VLANs as the lowest root cost path by default. If you want to adjust this behavior, this interface must effectively be penalized for the even-numbered VLANs to ensure that a more attractive path is via switch 2 (Fast Ethernet 0/21). If you have configured this correctly, as shown in Example 2-2, you have scored 3 points.

**Example 2-2  Sw3 VLAN Load Balancing Configuration and Verification**

```
SW3(config)# interface FastEthernet 0/19
SW3(config-if)# spanning-tree vlan 34,46,100,200 cost 100

SW3(config-if)# do show spanning-tree root
```

<table>
<thead>
<tr>
<th>Vlan</th>
<th>Root ID</th>
<th>Root Cost</th>
<th>Hello Time</th>
<th>Max Age</th>
<th>Fwd Dly</th>
<th>Root Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLAN0001</td>
<td>32769 0013.806d.9400</td>
<td>19</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>Fa0/19</td>
</tr>
<tr>
<td>VLAN0034</td>
<td>24610 0013.806d.9400</td>
<td>38</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>Fa0/21</td>
</tr>
<tr>
<td>VLAN0046</td>
<td>24622 0013.806d.9400</td>
<td>38</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>Fa0/21</td>
</tr>
<tr>
<td>VLAN0053</td>
<td>24629 0013.806d.9400</td>
<td>19</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>Fa0/19</td>
</tr>
<tr>
<td>VLAN0063</td>
<td>24639 0013.806d.9400</td>
<td>19</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>Fa0/19</td>
</tr>
<tr>
<td>VLAN0100</td>
<td>24678 0013.806d.9400</td>
<td>38</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>Fa0/21</td>
</tr>
<tr>
<td>VLAN0200</td>
<td>24776 0013.806d.9400</td>
<td>38</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>Fa0/21</td>
</tr>
</tbody>
</table>

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Switch 4 should use its interface directly connecting to switch 2 (Fast Ethernet 0/19) for traffic destined toward even-numbered VLANs (34, 46, 100, 200) and the interface directly connected to Switch 1 (Fast Ethernet 0/21) for odd-numbered VLANs (53, 63). (3 points)

Following from the previous question, to ensure a balanced access topology for VLAN load balancing, switch 4 uses the interface directly connecting to switch 1 (Fast Ethernet 0/21) for all VLANs as the lowest root cost path by default, rendering the second trunk connecting to switch 2 unused unless a failover condition occurs. As per the previous question, the directly connected interface to switch 1 must be penalized for the even-numbered VLANs. If you have configured this correctly, as shown in Example 2-3, you have scored 3 points.

Example 2-3  Sw4 VLAN Load Balancing Configuration and Verification

```
Sw4(config)# interface FastEthernet 0/21
Sw4(config-if)# spanning-tree vlan 34,46,100,200 cost 100
Sw4(config-if)# do show spanning-tree root
```

<table>
<thead>
<tr>
<th>Vlan</th>
<th>Root ID</th>
<th>Root Cost</th>
<th>Hello Time</th>
<th>Max Age</th>
<th>Fwd Dly</th>
<th>Root Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLAN0001</td>
<td>32769 0013.806d.9400</td>
<td>19</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>Fa0/21</td>
</tr>
<tr>
<td>VLAN0034</td>
<td>24610 0013.806d.9400</td>
<td>38</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>Fa0/19</td>
</tr>
<tr>
<td>VLAN0046</td>
<td>24622 0013.806d.9400</td>
<td>38</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>Fa0/19</td>
</tr>
<tr>
<td>VLAN0053</td>
<td>24629 0013.806d.9400</td>
<td>19</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>Fa0/21</td>
</tr>
<tr>
<td>VLAN0063</td>
<td>24639 0013.806d.9400</td>
<td>19</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>Fa0/21</td>
</tr>
<tr>
<td>VLAN100</td>
<td>24676 0013.806d.9400</td>
<td>38</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>Fa0/19</td>
</tr>
<tr>
<td>VLAN200</td>
<td>24776 0013.806d.9400</td>
<td>38</td>
<td>2</td>
<td>20</td>
<td>15</td>
<td>Fa0/19</td>
</tr>
</tbody>
</table>

Ensure a cable fault between Switches 1 and 2 does not result in one-way traffic between the two switches resulting in spanning-tree issues. (2 points)
UDLD detects unidirectional links on fiber-optic connections. In aggressive mode, UDLD also detects unidirectional links because of one-way traffic on twisted-pair links. By configuring the ports between switch 1 and switch 2 into aggressive mode, the switches become UDLD neighbors, are able to detect one-way links, and shut down the link should this condition arise to mitigate spanning-tree issues. If you have configured this correctly, as shown in Example 2-4, you have scored 2 points.

Example 2-4  Sw1 and Sw2 UDLD Configuration and Verification

```
SW1(config)# interface FastEthernet 0/23
SW1(config-if)# udld port aggressive

SW2(config)# interface FastEthernet 0/23
SW2(config-if)# udld port aggressive

SW1# show udld FastEthernet 0/23

Interface Fa0/23
...
Port enable administrative configuration setting: Enabled / in aggressive mode
Port enable operational state: Enabled / in aggressive mode
Current bidirectional state: Bidirectional
Current operational state: Advertisement - Single neighbor detected
Message interval: 15
Time out interval: 5

Entry 1
...
Expiration time: 44
Cache Device index: 1
```
Example 2-4  Sw1 and Sw2 UDLD Configuration and Verification  

Current neighbor state: Bidirectional
Device ID: CAT035N2G0
Port ID: Fa0/23
Neighbor echo 1 device: CAT091X17K
Neighbor echo 1 port: Fa0/23

Message interval: 15
Time out interval: 5
CDP Device name: SW2

- Configure switch 1 and switch 2 to allow connectivity of two more switches in the future to be connected into ports Fast Ethernet 0/18 on each switch. The new switches should be able to tunnel their own configured VLANs through a new VLAN (30) between switch 1 and switch 2. You have no requirement to configure a root bridge or VLAN load balancing for the new VLAN between switch 1 and switch 2. (4 points)

This is a service provider requirement whereby customers tunnel their own VLANs through the provider’s network. To mitigate any VLAN overlaps from other customers, you use a unique service provider VLAN to transport the customer VLANs. Example 2-5 shows VLAN30 being used to transport VLANs over a dot1q-tunnel. Use the show dot1q-tunnel command to verify your tunnel configuration on your switches. If you have configured this correctly, as shown in Example 2-5, you have scored 4 points.
Example 2-5  Sw1 and Sw2 Q in Q Configuration

```
Sw1(config)# vlan 30
Sw1(config-vlan)# exit
Sw1(config)# interface FastEthernet 0/18
Sw1(config-if)# switchport access vlan 30
Sw1(config-if)# switchport mode dot1q-tunnel

Sw2(config)# vlan 30
Sw2(config-vlan)# exit
Sw2(config)# interface FastEthernet 0/18
Sw2(config-if)# switchport access vlan 30
Sw2(config-if)# switchport mode dot1q-tunnel
```

Configure your switched network to monitor the VLAN200 interface associated with R2 (switch 2 Fast Ethernet 0/1), and send only traffic destined to R2 on this switch port across your network to switch 3 port Fast Ethernet 0/17. Use a new VLAN (20) to assist in this configuration. You have no requirement to configure a root bridge or VLAN load balancing for the new VLAN. (3 points)

This is a remote span question. The only complexity is based around the question statement of where you actually need to monitor: “traffic destined to R2.” As such, this means you need to configure the span parameters to send only the traffic transmitted out of the switch port toward R2, which is configured by the TX parameter. If this optional parameter is not configured, both transmit and receive traffic is monitored. Remote span requires a VLAN to propagate the span traffic between switches, which is why you need to configure VLAN20 on both switches 1 and 2. If you have configured this correctly, as shown in Example 2-6, you have scored 3 points.
Example 2-6  Sw2 and Sw3 Remote Span Configuration and Verification

SW2(config)# vlan 20
SW2(config-vlan)# remote-span
SW2(config-vlan)# exit
SW2(config)# monitor session 1 source interface fastEthernet 0/1 tx
SW2(config)# monitor session 1 destination remote vlan 20
SW2(config)# do show monitor session 1
Session 1

---------
Type      : Remote Source Session
Source Ports :
          TX Only : Fa0/1
Dest RSPAN VLAN : 20

SW3(config)# vlan 20
SW3(config-vlan)# exit
SW3(config)# monitor session 1 source remote vlan 20
SW3(config)# monitor session 1 destination interface fast 0/17
SW3(config)# do show monitor session 1
Session 1

---------
Type      : Remote Destination Session
Source RSPAN VLAN : 20
Destination Ports : Fa0/17
      Encapsulation : Native
           Ingress : Disabled
Configure the interface on switch 2 that connects to R5 VLAN53 (Fast Ethernet 0/5) in such a way that if all the trunks on switch 2 connecting to switch 1, switch 3, and switch 4 should fail, this Ethernet port transitions into error-disable state. (4 points)

The question requires link-state tracking to be configured. This feature provides redundancy in the network when used with server network interface card (NIC) adapter teaming. If a link is lost on the primary interface, connectivity is transparently switched to the secondary interface. Ports connected to servers are configured as downstream ports, and ports connected to other switches are configured as upstream ports. If the upstream trunk ports on switch 2 fail, link-state tracking automatically puts the downstream port connected to R5 into error-disable state. Example 2-7 shows the associated configuration and testing by shutting down the trunk ports on switch 2 that connect to switch 1, switch 3, and switch 4, which forces Fast Ethernet downstream ports into error-disable state. If you have configured this correctly, as shown in Example 2-7, you have scored 4 points.

Example 2-7  Sw2 Link-State Tracking Configuration and Verification

```
SW2(config)# link state track 1
SW2(config)# interface fast0/5
SW2(config-if)# link state group 1 downstream
SW2(config-if)# interface FastEthernet 0/19
SW2(config-if)# link state group 1 upstream
SW2(config-if)# interface FastEthernet 0/21
SW2(config-if)# link state group 1 upstream
SW2(config-if)# interface FastEthernet 0/23
SW2(config-if)# link state group 1 upstream

SW2# show interface FastEthernet 0/5 | include connected
FastEthernet0/5 is up, line protocol is up (connected)

SW2(config-if)# int fast 0/19
SW2(config-if)# shut
```
Example 2-7  Sw2 Link-State Tracking Configuration and Verification  continued

SW2(config-if)# int fast 0/21
SW2(config-if)# shut
SW2(config-if)# int fast 0/23
SW2(config-if)# shut

SW2# show interface FastEthernet 0/5 | include err-disabled
FastEthernet0/5 is down, line protocol is down (err-disabled)

- Your initial Frame Relay configuration has been supplied for the R1-R2-R3 connectivity. Configure Frame Relay as per Figure 2-6 to ensure that each device is reachable over the Frame Relay network. Only use the indicated DLCIs.  
  (2 points)

The initial Frame Relay configuration has been supplied for you; all you need to add are additional maps on R1 and R2 spokes to enable them to communicate with each other by directing traffic to the hub router (R3) because the initial configuration uses no inverse arp. If you have configured this correctly, as shown in Example 2-8, you have scored 2 points.

Example 2-8  R1 and R2 Additional Frame Relay Configuration and Testing

R1(config)# interface Serial0/0/0
R1(config-if)# frame-relay map ip 120.100.123.2 103 broadcast

R2(config)# interface Serial0/0
R2(config-if)# frame-relay map ip 120.100.123.1 203 broadcast

R1# ping 120.100.123.2
Example 2-8  R1 and R2 Additional Frame Relay Configuration and Testing  continued

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 120.100.123.2, timeout is 2 seconds:
!
Success rate is 100 percent (5/5), round-trip min/avg/max = 8/8/8 ms

Section 2: IPv4 IGP Protocols (28 Points)
You will now be answering questions in relation to EIGRP, OSPF, RIPv2, and redistribution between these protocols.

Section 2.1: EIGRP
- Configure Enhanced Interior Gateway Routing Protocol (EIGRP) as per Figure 2-7 using an AS of 1. Each EIGRP router should have its loopback 0 interface configured and advertised within EIGRP. (2 points)

This is a vanilla EIGRP configuration in preparation for the following questions. The only complexity is spotting the split-horizon issue with R3 over the physical Frame Relay network. By default R3 does not advertise the routes learned on its serial interface from R1 back out to R2 and vice versa because they all share the same interface. By disabling split-horizon for EIGRP on R3, you are permitting the routes to propagate. If you have configured this correctly, as shown in Example 2-9, you have scored 2 points.
Example 2-9  EIGRP Configuration and Verification

R1(config)# router eigrp 1
R1(config-router)# no auto-summary
R1(config-router)# net 120.100.1.0 0.0.0.255
R1(config-router)# net 120.100.123.0 0.0.0.255
R1(config-router)# net 120.100.100.0 0.0.0.255

R2(config)# router eigrp 1
R2(config-router)# no auto-summary
R2(config-router)# network 120.100.2.0 0.0.0.255
R2(config-router)# network 120.100.123.0 0.0.0.255
R2(config-router)# network 120.100.200.0 0.0.0.255

R3(config-if)# router eigrp 1
R3(config-router)# no auto-summary
R3(config-router)# network 120.100.3.0 0.0.0.255
R3(config-router)# network 120.100.123.0 0.0.0.255
R3(config-router)# network 120.100.34.0 0.0.0.255

R4(config-router)# router eigrp 1
R4(config-router)# no auto-summary
R4(config-router)# network 120.100.4.0 0.0.0.255
R4(config-router)# network 120.100.34.0 0.0.0.255

R5(config)# router eigrp 1
R5(config-router)# no auto-summary
R5(config-router)# network 120.100.5.0 0.0.0.255
R5(config-router)# network 120.100.34.0 0.0.0.255
Example 2-9  EIGRP Configuration and Verification  continued

R1# show ip route eigrp
   120.0.0.0/8 is variably subnetted, 7 subnets, 1 mask
   D  120.100.4.0/24 [90/2300416] via 120.100.123.3, 00:14:51, Serial0/0/0
   D  120.100.5.0/24 [90/2300416] via 120.100.123.3, 00:01:32, Serial0/0/0
   D  120.100.3.0/24 [90/2297856] via 120.100.123.3, 00:42:12, Serial0/0/0
   D  120.100.34.0/24 [90/2172416] via 120.100.123.3, 00:41:54, Serial0/0/0

R3# show ip route eigrp
   120.0.0.0/8 is variably subnetted, 9 subnets, 1 mask
   D  120.100.4.0/24
       [90/156160] via 120.100.34.4, 00:19:14, GigabitEthernet0/0
   D  120.100.5.0/24
       [90/156160] via 120.100.34.5, 00:05:55, GigabitEthernet0/0
   D  120.100.1.0/24 [90/2297856] via 120.100.123.1, 00:46:35, Serial0/0/0
   D  120.100.2.0/24 [90/2297856] via 120.100.123.2, 00:46:35, Serial0/0/0
   D  120.100.100.0/24 [90/2172416] via 120.100.123.1, 00:46:35, Serial0/0/0
   D  120.100.200.0/24 [90/2172416] via 120.100.123.2, 00:46:35, Serial0/0/0

R2# show ip route eigrp
   120.0.0.0/8 is variably subnetted, 8 subnets, 1 mask
   D  120.100.4.0/24 [90/2300416] via 120.100.123.3, 00:19:55, Serial0/0
   D  120.100.5.0/24 [90/2300416] via 120.100.123.3, 00:06:36, Serial0/0
   D  120.100.3.0/24 [90/2297856] via 120.100.123.3, 00:47:16, Serial0/0
   D  120.100.34.0/24 [90/2172416] via 120.100.123.3, 00:46:58, Serial0/0

R3(config)# interface Serial0/0/0
R3(config-if)# no ip split-horizon eigrp 1
Example 2-9  EIGRP Configuration and Verification  continued

```
R1# show ip route eigrp
    120.0.0.0/8 is variably subnetted, 10 subnets, 1 mask
    D  120.100.4.0/24 [90/2300416] via 120.100.123.3, 00:14:51, Serial0/0/0
    D  120.100.5.0/24 [90/2300416] via 120.100.123.3, 00:14:30, Serial0/0/0
    D  120.100.2.0/24 [90/2809856] via 120.100.123.3, 00:38:32, Serial0/0/0
    D  120.100.3.0/24 [90/2297856] via 120.100.123.3, 00:42:12, Serial0/0/0
    D  120.100.4.0/24 [90/2172416] via 120.100.123.3, 00:41:54, Serial0/0/0
    D  120.100.200.0/24 [90/2684416] via 120.100.123.3, 00:38:32, Serial0/0/0
R1#
```

```
R2# show ip route eigrp
    120.0.0.0/8 is variably subnetted, 10 subnets, 1 mask
    D  120.100.4.0/24 [90/2300416] via 120.100.123.3, 00:24:43, Serial0/0
    D  120.100.5.0/24 [90/2300416] via 120.100.123.3, 00:11:24, Serial0/0
    D  120.100.1.0/24 [90/2809856] via 120.100.123.3, 00:48:24, Serial0/0
    D  120.100.3.0/24 [90/2297856] via 120.100.123.3, 00:52:04, Serial0/0
    D  120.100.4.0/24 [90/2172416] via 120.100.123.3, 00:51:46, Serial0/0
    D  120.100.100.0/24 [90/2684416] via 120.100.123.3, 00:48:24, Serial0/0
```

- Configure R1 to advertise a summary route of 120.100.0.0/16 outbound on its serial interface. R3 should see the original VLAN100 and loopback 0 individual routes in addition to the summary route. You can use only one summary route in your configuration. (3 points)

By default, summarization blocks all longer prefixes covered by the supernet configured on an interface. As such, the VLAN100 and loopback 0 route from R1 would not be seen by R3. Allowing specific routes to be advertised in conjunction with summary routes can be a valid requirement. One method used to achieve this is by configuring multiple summary routes, but the question does not permit this approach. To facilitate the specific routes in conjunction with the summary, a leak map should be configured to match the VLAN100 and loopback 0 interfaces on R1. The leak map,
which is configured as per a normal route map, is then applied to the standard summary route statement on R1. If you have configured this correctly, as shown in Example 2-10, you have scored 3 points.

**Example 2-10  R1 Leak Map Configuration and Verification**

```
R1(config)# route-map LEAK-VLAN-100-L00P0 permit 10
R1(config-route-map)# match ip address 1
R1(config-route-map)# exit
R1(config)# access-list 1 permit 120.100.100.0
R1(config)# access-list 1 permit 120.100.1.0
R1(config)# interface Serial0/0
R1(config-if)# ip summary-address eigrp 1 120.100.0.0 255.255.0.0 leak-map LEAK-VLAN-100-L00P0
```

R3# show ip route eigrp

```
  120.0.0.0/8 is variably subnetted, 10 subnets, 2 masks
  D 120.100.4.0/24 [90/158160] via 120.100.34.4, 00:19:14, GigabitEthernet0/0
  D 120.100.5.0/24 [90/158160] via 120.100.34.5, 00:05:55, GigabitEthernet0/0
  D 120.100.0.0/16 [90/2172416] via 120.100.123.1, 00:34:39, Serial0/0/0
  D 120.100.1.0/24 [90/2297856] via 120.100.123.1, 00:46:35, Serial0/0/0
  D 120.100.2.0/24 [90/2297856] via 120.100.123.2, 00:46:35, Serial0/0/0
  D 120.100.100.0/24 [90/2172416] via 120.100.123.1, 00:46:35, Serial0/0/0
  D 120.100.200.0/24 [90/2172416] via 120.100.123.2, 00:46:35, Serial0/0/0
```

■ Ensure that the length of time that EIGRP considers neighbors to be valid without receiving a hello packet on the Frame Relay network between R1, R2, and R3 is 200 seconds. Do not change the hello-interval parameter. (2 points)
EIGRP considers neighbors to be valid up to three times the hello interval. The Frame Relay network is considered a slow speed link, and hello packets are sent every 60 seconds. Usually you could tune the hold time by manipulating the hello intervals on an interface, but this question ensures that you can achieve the desired result only by manually changing the hold time to 200 under the Frame Relay interface of routers R1, R2, and R3. Example 2-11 shows the required configuration and verification of hold time by displaying the neighbor’s statistics as seen by R3. If you have configured this correctly, as shown in Example 2-11, you have scored 2 points.

Example 2-11  EIGRP Hold Timer Configuration and Verification

R1(config)# interface Serial0/0/0
R1(config-if)# ip hold-time eigrp 1 200
R1(config-if)

Enter configuration commands, one per line. End with CNTL/Z.
R2(config)# interface Serial0/0
R2(config-if)# ip hold-time eigrp 1 200
R2(config-if)

R3(config)# interface Serial0/0/0
R3(config-if)# ip hold-time eigrp 1 200
R3(config-if)# do sh ip eigrp neighbors

IP-EIGRP neighbors for process 1

<table>
<thead>
<tr>
<th>H</th>
<th>Address</th>
<th>Interface</th>
<th>Hold Uptime</th>
<th>SRTT</th>
<th>RTO</th>
<th>Q</th>
<th>Seq</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>120.100.123.1</td>
<td>Se0/0/0</td>
<td>198 00:00:57</td>
<td>3</td>
<td>200</td>
<td>0</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>120.100.123.2</td>
<td>Se0/0/0</td>
<td>199 00:01:00</td>
<td>3</td>
<td>200</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>1</td>
<td>120.100.34.5</td>
<td>Gi0/0</td>
<td>12 00:23:32</td>
<td>1</td>
<td>200</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>0</td>
<td>120.100.34.4</td>
<td>Gi0/0</td>
<td>12 00:23:35</td>
<td>35</td>
<td>210</td>
<td>0</td>
<td>22</td>
</tr>
</tbody>
</table>
Configure new loopback interfaces on R1 and R2 using a loopback interface 2 with an identical IP address of 150.101.1.1/24 on both routers. Advertise this network into EIGRP on each router. Ensure that R3 prefers the route from R2 by manipulating the delay associated with this route. Do not manually adjust the delay associated with the interface by use of the delay command. You are permitted to configure only R2 to influence the delay. (3 points)

R3 receives identical routes from both R1 and R2 for network 150.101.1.0/24. As such, both routes are stored in the topology and routing table. R2 could influence the metric calculated by R3 by manipulating the delay of the new loopback interface or of the serial Frame Relay interface connecting directly to R3, but this is not permitted. Because configuration is required solely on R2, the only method available is to create an offset list that allows you to match specific routes and append further delay to them as they are advertised on R2 toward R3. If the offset list is not applied to the Frame Relay interface, it would affect the whole process and not just advertisements toward R3.

Example 2-12 shows the configuration required to advertise the new routes and the routes as they are received on R3. Initial delay is shown to be 25,000 µ seconds. Post-configuration of the offset list on R2 the delay is seen to increase to 25,003 µ seconds for the route received from R2. As such, the route installed into the routing table of R3 is then the original advertised from R1 with the more appealing value of 25,000 µ seconds. If you have configured this correctly, as shown in Example 2-12, you have scored 3 points.

**Example 2-12  EIGRP Configuration and Verification**

```
R1(config)# interface Loopback2
R1(config-if)# ip address 150.101.1.1 255.255.255.0
R1(config-if)# router eigrp 1
R1(config-router)# net 150.101.1.0 0.0.0.255

R2(config)# interface Loopback2
R2(config-if)# ip address 150.101.1.1 255.255.255.0
R2(config-if)# router eigrp 1
R2(config-router)# net 150.101.1.0 0.0.0.255
```
Example 2-12  EIGRP Configuration and Verification  continued

R3# show ip route 150.101.1.0
Routing entry for 150.101.1.0/24
    Known via 'eigrp 1', distance 90, metric 2297866, type internal
    Redistributing via eigrp 1
    Last update from 120.100.123.2 on Serial0/0/0, 00:02:51 ago
Routing Descriptor Blocks:
  120.100.123.2, from 120.100.123.2, 00:02:51 ago, via Serial0/0/0
    Route metric is 2297866, traffic share count is 1
    Total delay is 25000 microseconds, minimum bandwidth is 1544 Kbit
    Reliability 255/255, minimum MTU 1500 bytes
    Loading 1/255, Hops 1
  * 120.100.123.1, from 120.100.123.1, 00:02:51 ago, via Serial0/0/0
    Route metric is 2297866, traffic share count is 1
    Total delay is 25000 microseconds, minimum bandwidth is 1544 Kbit
    Reliability 255/255, minimum MTU 1500 bytes
    Loading 1/255, Hops 1

R3# show ip eigrp topology 150.101.1.0 255.255.255.0
IP-EIGRP (AS 1): Topology entry for 150.101.1.0/24
    State is Passive, Query origin flag is 1, 2 Successor(s), FD is 2297866
Routing Descriptor Blocks:
  120.100.123.2 (Serial0/0/0), from 120.100.123.2, Send flag is 0x0
    Composite metric is (2297866/128256), Route is Internal
    Vector metric:
      Minimum bandwidth is 1544 Kbit
Example 2-12  EIGRP Configuration and Verification  continued

Total delay is 25000 microseconds
Reliability is 255/255
Load is 1/255
Minimum MTU is 1500
Hop count is 1
120.100.123.1 (Serial0/0/0), from 120.100.123.1, Send flag is 0x0
Composite metric is (2297856/128256), Route is Internal
Vector metric:
  Minimum bandwidth is 1544 Kbit

Total delay is 25000 microseconds
Reliability is 255/255
Load is 1/255
Minimum MTU is 1500
Hop count is 1

R2(config-router)# do show interface Serial0/0
Serial0/0 is up, line protocol is up
  Hardware is GT96K Serial
  Internet address is 120.100.123.2/24
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, reliability 255/255, txload 1/255, rxload 1/255

R2(config)# access-list 1 permit 150.101.1.0
R2(config)# router eigrp 1
R2(config-router)# offset-list 1 out 100 Serial0/0
Example 2-12  EIGRP Configuration and Verification  continued

R3# show ip route 150.101.1.0
Routing entry for 150.101.1.0/24
   Known via 'eigrp 1", distance 90, metric 2297856, type internal
   Redistributing via eigrp 1
   Last update from 120.100.123.1 on Serial0/0/0, 00:00:18 ago
   Routing Descriptor Blocks:
      * 120.100.123.1, from 120.100.123.1, 00:00:18 ago, via Serial0/0/0
         Route metric is 2297856, traffic share count is 1
         Total delay is 25000 microseconds, minimum bandwidth is 1544 Kbit
         Reliability 255/255, minimum MTU 1500 bytes
         Loading 1/255, Hops 1

R3# show ip eigrp topology 150.101.1.0 255.255.255.0
IP-EIGRP (AS 1): Topology entry for 150.101.1.0/24
   State is Passive, Query origin flag is 1, 1 Successor(s), FD is 2297856
   Routing Descriptor Blocks:
      120.100.123.1 (Serial0/0/0), from 120.100.123.1, Send flag is 0x0
         Composite metric is (2297856/128256), Route is Internal
         Vector metric:
            Minimum bandwidth is 1544 Kbit
            Total delay is 25000 microseconds
            Reliability is 255/255
            Load is 1/255
            Minimum MTU is 1500
            Hop count is 1
      120.100.123.2 (Serial0/0/0), from 120.100.123.2, Send flag is 0x0
Example 2-12  EIGRP Configuration and Verification  continued

- Composite metric is (229756/128356), Route is Internal
- Vector metric:
  - Minimum bandwidth is 1544 Kbit
  - Total delay is 25003 microseconds
- Reliability is 255/255
- Load is 1/255
- Minimum MTU is 1500
- Hop count is 1

Section 2.2: OSPF

- Configure Open Shortest Path First (OSPF) as per Figure 2-8 using a process ID of 1. Where possible, all OSPF configuration should not be configured under the process ID. Each OSPF router should also have its loopback 0 interface configured and advertised within OSPF as follows: (2 points)
  - R4 Loopback 0 - Area 0
  - R5 Loopback 0 - Area 0
  - R6 Loopback 0 - Area 1
  - Sw1 Loopback 0 - Area 2
  - Sw2 Loopback 0 - Area 1
  - Sw3 Loopback 0 - Area 2
  - Sw4 Loopback 0 - Area 3
As per Lab 1, the question directs you to configure OSPF directly under the interfaces of the routers. The switches still require configuration under the OSPF process running this version of IOS. Did you notice that area 0 is partitioned? If you have configured this correctly, as shown in Example 2-13, you have scored 2 points. Consider using the `show ip ospf interface` command to verify your configuration.

Example 2-13  Initial OSPF Configuration

```plaintext
R4(config)# interface Loopback 0
R4(config-if)# ip ospf 1 area 0
R4(config-if)# exit
R4(config)# interface GigabitEthernet 0/1
R4(config-if)# ip ospf 1 area 1

R5(config)# interface Loopback 0
R5(config-if)# ip ospf 1 area 0
R5(config-if)# exit
R5(config)# interface GigabitEthernet 0/1
R5(config-if)# ip ospf 1 area 2

R6(config)# interface Loopback 0
R6(config-if)# ip ospf 1 area 1
R6(config-if)# interface GigabitEthernet 0/0
R6(config-if)# ip ospf 1 area 1
R6(config-if)# interface GigabitEthernet 0/1
R6(config-if)# ip ospf 1 area 3

SW1(config)# ip routing
SW1(config)# router ospf 1
```
NOTE
If you are using the CCIE Assessor or have your own topology with 3550s, you experience neighbor relationship problems running OSPF to your routers or 3560s. This is because the default MTU value is 1504 on the 3550 VLAN interface and 1500 on the routers and 3560s. Example 2-14 shows the adjacency issues with switch 1 (3550 in this scenario) on R5. By debugging OSPF adjacency you can see that switch 1 has a larger default MTU, which ensures that the neighbor adjacency is only ever partial. The example also shows the switch 3 (3560) default MTU value on the same VLAN53 and the MTU modification required on switch 1. You get no extra points if you needed to configure this workaround. If you didn’t spot this, you would lose points in this section because you don’t have full neighbor adjacencies on switch 1. This type of issue shows just how important it is to constantly validate your configurations as opposed to simply expecting everything to work.

Example 2-13  Initial OSPF Configuration  continued

SW1(config-router)# network 120.100.7.1 0.0.0.0 area 2
SW1(config-router)# network 120.100.53.1 0.0.0.0 area 2

SW2(config)# ip routing
SW2(config-if)# router ospf 1
SW2(config-router)# net 120.100.8.1 0.0.0.0 area 1
SW2(config-router)# net 120.100.46.2 0.0.0.0 area 1

SW3(config)# ip routing
SW3(config)# router ospf 1
SW3(config-router)# network 120.100.53.3 0.0.0.0 area 2
SW3(config-router)# network 120.100.63.3 0.0.0.0 area 3
SW3(config-router)# network 120.100.9.1 0.0.0.0 area 2

SW4(config)# ip routing
SW4(config)# router ospf 1
SW4(config-router)# network 120.100.10.1 0.0.0.0 area 3
SW4(config-router)# network 120.100.63.4 0.0.0.0 area 3
Example 2-14  R5-Sw1 OSPF Neighbor Issues

R5# show ip ospf neighbor

<table>
<thead>
<tr>
<th>Neighbor ID</th>
<th>Pri</th>
<th>State</th>
<th>Dead Time</th>
<th>Address</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>120.100.7.1</td>
<td>1</td>
<td>EXSTART/DROther</td>
<td>00:00:35</td>
<td>120.100.53.1</td>
<td>GigabitEthernet0/1</td>
</tr>
<tr>
<td>t0/1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120.100.9.1</td>
<td>1</td>
<td>FULL/DR</td>
<td>00:00:38</td>
<td>120.100.53.3</td>
<td>GigabitEthernet0/1</td>
</tr>
<tr>
<td>t0/1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R5# debug ip ospf adjacency

May 8 20:38:41.059: OSPF: Nbr 120.100.7.1 has larger interface MTU

R5#

R5# show interface GigabitEthernet0/0 | begin MTU

MTU 1500 bytes, BW 100000 Kbit, DLY 100 usec,

SW1# show interface vlan 53 | begin MTU

MTU 1504 bytes, BW 1000000 Kbit, DLY 10 usec

SW3# show interface vlan 53 | beg MTU

MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec,

SW1(config-if)# int vlan 53
SW1(config-if)# ip mtu 1500

R5# show ip ospf neighbor

<table>
<thead>
<tr>
<th>Neighbor ID</th>
<th>Pri</th>
<th>State</th>
<th>Dead Time</th>
<th>Address</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>120.100.7.1</td>
<td>1</td>
<td>FULL/DROther</td>
<td>00:00:34</td>
<td>120.100.53.1</td>
<td>GigabitEthernet0/1</td>
</tr>
<tr>
<td>120.100.9.1</td>
<td>1</td>
<td>FULL/DR</td>
<td>00:00:37</td>
<td>120.100.53.3</td>
<td>GigabitEthernet0/1</td>
</tr>
</tbody>
</table>
Area 0 is partitioned between R4 and R5. Ensure that your network can accommodate this issue. You are not permitted to form any area 0 neighbor relationship directly between R4 and R5 to join area 0. (4 points)

A fundamental rule of OSPF is not to design your network with a partitioned backbone area 0 or partition in the event of a failure condition. A virtual link between R4 and R5 would not work here because you would need to transit multiple OSPF areas. A tunnel between the two routers is also not permitted because this would form a direct neighbor relationship. You are required to configure a virtual link between R5 and switch 3 to propagate area 3 routes and similarly between R4 and R6. By then creating an additional virtual link between R6 and switch 3, the two effective halves of the network have been joined at an area 0 level.

Remember to configure all virtual links to the router ID of the remote router as opposed to the physical IP address on the corresponding interface. Example 2-15 shows the required configuration to create virtual links between R5-SW3, R4-R6, and R6-SW3. The resulting routing table verification on switch 4 shows all networks are being learned correctly post-configuration. If you have configured this correctly, as shown in Example 2-15, you have scored 4 points.
Example 2-15  OSPF Virtual-Link Configuration and Routing Table Verification

R5(config)# router ospf 1
R5(config-router)# area 2 virtual-link 120.100.9.1

SW3(config-router)# router ospf 1
SW3(config-router)# area 2 virtual-link 120.100.5.1

R4(config)# router ospf 1
R4(config-router)# area 1 virtual-link 120.100.6.1

R6(config-if)# router ospf 1
R6(config-router)# area 1 virtual-link 120.100.4.1
R6(config-router)# area 3 virtual-link 120.100.9.1

SW3(config-if)# router ospf 1
SW3(config-router)# area 3 virtual-link 120.100.6.1

SW4# sh ip route ospf
  120.0.0.0/8 is variably subnetted, 10 subnets, 2 masks
  0 IA  120.100.9.1/32 [110/2] via 120.100.63.3, 00:00:54, Vlan63
  0 IA  120.100.8.1/32 [110/3] via 120.100.63.6, 00:00:54, Vlan63
  0 IA  120.100.5.1/32 [110/3] via 120.100.63.3, 00:00:54, Vlan63
  0 IA  120.100.4.1/32 [110/3] via 120.100.63.6, 00:00:54, Vlan63
  0 IA  120.100.7.1/32 [110/3] via 120.100.63.3, 00:00:54, Vlan63
  0 IA  120.100.6.1/32 [110/2] via 120.100.63.6, 00:00:54, Vlan63
  0 IA  120.100.53.0/24 [110/2] via 120.100.63.3, 00:00:54, Vlan63
  0 IA  120.100.46.0/24 [110/2] via 120.100.63.6, 00:00:55, Vlan63
Section 2.3: RIPv2

- Configure RIPv2 between R2 and R3, per Figure 2-9. Configure a new loopback interface on R2 (loopback 3) with an IP address of 150.101.2.1/24. Advertise this and only this network to R3 from R2. (2 points)

Although RIPv2 is capable of variable-length subnet mask (VLSM), it nevertheless is based on a classful protocol that by default advertises all the connected interfaces of both R2 and R3 when the classful network command activates the routing process. To restrict advertisement to solely the new loopback interface from R2, you need a basic distribute list. This should be applied either on the entire process or just on the Frame Relay interface connecting to R3. It should permit only the new loopback subnet of 150.101.2.0/24.

If you’re low on time, you can check the routing table of R3 to find that the only RIPv2 route received is that of the new loopback 3 interface on R2. This is because the VLAN200 and loopback 0 interfaces of R2 are already being learned via EIGRP, which, of course, has a lower admin distance and therefore is not listed as a RIPv2 route within the routing table. Example 2-16 shows the basic RIPv2 configuration on R2 and R3 with a debug of RIPv2 updates on R2 to illustrate which routes are being advertised to R3. The required distribute list configuration is also shown. If you have configured this correctly, as shown in Example 2-16, you have scored 2 points.

Example 2-16   R2 and R3 RIPv2 Configuration and Verification

R2(config)# interface Loopback3
R2(config-if)# ip add 150.101.2.1 255.255.255.0
R2(config-if)# router rip
R2(config-if-router)# version 2
R2(config-router)# no auto-summary
R2(config-router)# network 150.101.0.0
R2(config-router)# network 120.0.0.0

R3(config)# router rip
R3(config-router)# version 2
R3(config-router)# no auto-summary
Example 2-16  R2 and R3 RIPv2 Configuration and Verification  continued

R3(config-router)# network 120.0.0.0
R3(config-router)# do show ip route rip
  150.101.0.0/24 is subnetted, 2 subnets
R    150.101.2.0 [120/1] via 120.100.123.2, 00:00:05, Serial0/0/0

R2# sh ip route rip

R2# debug ip rip
*May 8 05:00:22.147: RIP: sending v2 update to 224.0.0.9 via Serial0/0 (120.100 .123.2)
*May 8 05:00:22.147: RIP: build update entries
*May 8 05:00:22.147: 120.100.2.0/24 via 0.0.0.0, metric 1, tag 0
*May 8 05:00:22.147: 120.100.123.0/24 via 0.0.0.0, metric 1, tag 0
*May 8 05:00:22.147: 120.100.200.0/24 via 0.0.0.0, metric 1, tag 0
*May 8 05:00:22.147: 150.101.1.0/24 via 0.0.0.0, metric 1, tag 0
*May 8 05:00:22.147: 150.101.2.0/24 via 0.0.0.0, metric 1, tag 0

R2(config)# router rip
R2(config-router)# distribute-list 2 out Serial0/0
R2(config-router)# exit
R2(config)# access-list 2 permit 150.101.2.0
R2(config)# exit
*May 8 05:02:40.271: RIP: sending v2 update to 224.0.0.9 via Serial0/0 (120.100 .123.2)
*May 8 05:02:40.271: RIP: build update entries
*May 8 05:02:40.271: 150.101.2.0/24 via 0.0.0.0, metric 1, tag 0
R2#

R3# show ip route rip
  150.101.0.0/24 is subnetted, 2 subnets
R    150.101.2.0 [120/1] via 120.100.123.2, 00:00:02, Serial0/0/0

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R3 should not advertise any connected interfaces into Routing Information Protocol version 2 (RIPv2). Do not filter routing advertisements to achieve this behavior. (2 points)

Because you are not permitted to filter routes, as per the previous question, you simply configure the Frame Relay interfaces to be passive on R3. This allows routing updates to be received inbound but stops routing advertisements outbound. Example 2-17 shows the RIPv2 routes advertised originally from R3 being received by R2 with the required configuration for R3. If you have configured this correctly, you have scored 2 points.

Example 2-17    R3 RIPv2 Configuration and Verification

```
R2# debug ip rip
*May 8 05:05:10.031: RIP: received v2 update from 120.100.123.3 on Serial0/0
*May 8 05:05:10.031:     120.100.3.0/24 via 0.0.0.0 in 1 hops
*May 8 05:05:10.031:     120.100.34.0/24 via 0.0.0.0 in 1 hops
*May 8 05:05:10.031:     120.100.123.0/24 via 0.0.0.0 in 1 hops
```

```
R3(config)# router rip
R3(config-router)# passive-interface Serial0/0/0
```

Section 2.4: Redistribution

Perform a one-way redistribution of RIPv2 into EIGRP on R3 using the following default metric 1544 20000 255 1 1500. Ensure that R1 shows a next hop for the RIPv2 advertised route of 150.101.2.0/24 of R2. Perform configuration only on R3 for this task. (3 points)

This is a simple redistribution question. On inspection you might believe the only complexity is that of modifying the next hop attribute for R1, which would by default show as R3 for the RIPv2 route advertised by R2. In fact, you would
find that the RIPv2 route would not be seen on R1 post-redistribution from R3. This is because of an inherent safety
mechanism within EIGRP that causes redistribution issues with routers that have duplicate EIGRP router IDs. Prelab
configuration ensured that both R1 and R2 have the same loopback 255 IP address, which forces the router ID to be
identical.

Example 2-18 shows the redistribution configuration on R3. The RIPv2 route of 150.101.2.0/24 is received on R3 but is
absent on R1. Inspection of the EIGRP topology table for the route on R3 shows that it is being advertised into EIGRP
and that the router ID of R3 is 200.200.200.200. Similarly, the router ID of R1 is also 200.200.200.200. By changing the
router ID of R3 to that of its loopback 0 interface (120.100.3.1), the route is then accepted by R1. But, of course, a next
hop is shown as R3 even though R2 resides on the same IP subnet as R1 and R2 and is the originating router. The EIGRP
third-party next hop feature can be used to modify the next hop attribute with a router redistributing another routing
protocol into EIGRP in a similar manner to that of BGP. If you have configured this correctly, as shown in Example 2-18,
you have scored 3 points.

**Example 2-18  R3 RIPv2 Redistribution Configuration and Verification**

R3(config)# router eigrp 1
R3(config-router)# redistribute rip
R3(config-router)# default-metric 1544 20000 255 1 1500

R3# show ip route rip
150.101.0.0/24 is subnetted, 2 subnets
R  150.101.2.0 [120/1] via 120.100.123.2, 00:00:06, Serial0/0/0

R1# show ip route 150.101.2.0
% Subnet not in table
Example 2-18   R3 RIPv2 Redistribution Configuration and Verification  continued

R3# show ip eigrp topology 150.101.2.0 255.255.255.0
IP-EIGRP (AS 1): Topology entry for 150.101.2.0/24
   State is Passive, Query origin flag is 1, 1 Successor(s), FD is 6777856
   Routing Descriptor Blocks:
      120.100.123.2, from redistributed, Send flag is 0x0
      Composite metric is (6777856/0), Route is External
      Vector metric:
         Minimum bandwidth is 1544 Kbit
         Total delay is 200000 microseconds
         Reliability is 255/255
         Load is 1/255
         Minimum MTU is 1500
         Hop count is 0
      External data:
         Originating router is 200.200.200.200 (this system)
         AS number of route is 0
         External protocol is RIP, external metric is 1
         Administrator tag is 0 (0x00000000)

R3# show ip eigrp topology | include ID
IP-EIGRP Topology Table for AS(1)/ID(200.200.200.200)
R3#

R1# show ip eigrp topology | include ID
IP-EIGRP Topology Table for AS(1)/ID(200.200.200.200)
R1#
Example 2-18  R3 RIPv2 Redistribution Configuration and Verification  continued

R3(config)# router eigrp 1
R3(config-router)# eigrp router-id 120.100.3.1

R3# show ip eigrp topology | include ID
IP-EIGRP Topology Table for AS(1)/ID(120.100.3.1)

R3# show ip eigrp topology 150.101.2.0 255.255.255.0
IP-EIGRP (AS 1): Topology entry for 150.101.2.0/24
  State is Passive, Query origin flag is 1, 1 Successor(s), FD is 6777856
  Routing Descriptor Blocks:
    120.100.123.2, from Distributed, Send flag is 0x0
    Composite metric is (6777856/0), Route is External
      Vector metric:
        Minimum bandwidth is 1544 Kbit
        Total delay is 2000000 microseconds
        Reliability is 255/255
        Load is 1/255
        Minimum MTU is 1500
        Hop count is 0
  External data:
    Originating router is 120.100.3.1 (this system)
    AS number of route is 0
    External protocol is RIP, external metric is 1
    Administrator tag is 0 (0x00000000)

R1# show ip route 150.101.2.0
Routing entry for 150.101.2.0/24
  Known via 'eigrp 1", distance 170, metric 7289856, type external
Example 2-18  R3 RIPv2 Redistribution Configuration and Verification  

Redistributing via eigrp 1
Last update from 120.100.123.3 on Serial0/0/0, 00:03:06 ago
Routing Descriptor Blocks:
  * 120.100.123.3, from 120.100.123.3, 00:03:06 ago, via Serial0/0/0
    Route metric is 7280856, traffic share count is 1
    Total delay is 220000 microseconds, minimum bandwidth is 1544 Kbit
    Reliability 255/255, minimum MTU 1500 bytes
    Loading 1/255, Hops 1

R3(config-if)# interface Serial0/0/0
R3(config-if)# no ip next-hop-self eigrp 1
R4# show ip route 150.101.2.0
Routing entry for 150.101.2.0/24
  Known via 'eigrp 1", distance 170, metric 7280856, type external
  Redistributing via eigrp 1
  Last update from 120.100.123.2 on Serial0/0/0, 00:00:24 ago
Routing Descriptor Blocks:
  * 120.100.123.2, from 120.100.123.3, 00:00:24 ago, via Serial0/0/0
    Route metric is 7280856, traffic share count is 1
    Total delay is 220000 microseconds, minimum bandwidth is 1544 Kbit
    Reliability 255/255, minimum MTU 1500 bytes
    Loading 1/255, Hops 1

■ Perform mutual redistribution of EIGRP and OSPF on R4 and R5. Use a metric of 5000 for redistributed routes into OSPF, which should appear as external type 2 routes, and the following K values for OSPF routes redistributed into EIGRP: 1544 20000 255 1 1500. (2 points)
This is an unambiguous redistribution question that sets the scene for the question that follows. Example 2-19 shows the required configuration on R4 and R5 with verification of external EIGRP received routes on R3. Because the metrics are identical on R4 and R5, you have multiple routes with load-sharing potential. If you have configured this correctly, you have scored 2 points.

Example 2-19  R4 and R5 Redistribution Configuration and Verification on R3

R4(config-router)# router ospf 1
R4(config-router)# redistribute eigrp 1 subnets
R4(config-router)# default-metric 5000
R4(config-router)# router eigrp 1
R4(config-router)# redistribute ospf 1
R4(config-router)# default-metric 1544 20000 255 1 1500

R5(config-router)# router ospf 1
R5(config-router)# redistribute eigrp 1 subnets
R5(config-router)# default-metric 5000
R5(config-router)# router eigrp 1
R5(config-router)# redistribute ospf 1
R5(config-router)# default-metric 1544 20000 255 1 1500

R3# show ip route eigrp
    150.101.0.0/24 is subnetted, 2 subnets
D    150.101.1.0 [50/2297856] via 120.100.123.1, 00:05:05, Serial0/0/0
    120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
D EX   120.100.9.1/32
    [170/6780416] via 120.100.34.5, 00:00:22, GigabitEthernet0/0
    [170/6780416] via 120.100.34.4, 00:00:22, GigabitEthernet0/0

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Example 2-19  R4 and R5 Redistribution Configuration and Verification on R3  

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>D EX</td>
<td>120.100.8.1/32</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[170/8780416] via 120.100.34.5, 00:00:22, GigabitEthernet0/0</td>
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<tr>
<td></td>
<td>[170/8780416] via 120.100.34.4, 00:00:22, GigabitEthernet0/0</td>
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<tr>
<td>D EX</td>
<td>120.100.10.1/32</td>
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<tr>
<td></td>
<td>[170/8780416] via 120.100.34.5, 00:00:22, GigabitEthernet0/0</td>
<td></td>
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<tr>
<td></td>
<td>[170/8780416] via 120.100.34.4, 00:00:22, GigabitEthernet0/0</td>
<td></td>
</tr>
<tr>
<td>D EX</td>
<td>120.100.5.1/32</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[170/8780416] via 120.100.34.4, 00:01:51, GigabitEthernet0/0</td>
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<tr>
<td>D</td>
<td>120.100.4.0/24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[90/156160] via 120.100.34.4, 00:07:17, GigabitEthernet0/0</td>
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</tr>
<tr>
<td>D</td>
<td>120.100.5.0/24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[90/156160] via 120.100.34.5, 00:07:17, GigabitEthernet0/0</td>
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</tr>
<tr>
<td>D EX</td>
<td>120.100.4.1/32</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[170/8780416] via 120.100.34.5, 00:00:23, GigabitEthernet0/0</td>
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</tr>
<tr>
<td>D EX</td>
<td>120.100.7.1/32</td>
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</tr>
<tr>
<td></td>
<td>[170/8780416] via 120.100.34.5, 00:00:23, GigabitEthernet0/0</td>
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<tr>
<td></td>
<td>[170/8780416] via 120.100.34.4, 00:00:23, GigabitEthernet0/0</td>
<td></td>
</tr>
<tr>
<td>D EX</td>
<td>120.100.6.1/32</td>
<td></td>
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<tr>
<td></td>
<td>[170/8780416] via 120.100.34.5, 00:00:24, GigabitEthernet0/0</td>
<td></td>
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<tr>
<td></td>
<td>[170/8780416] via 120.100.34.4, 00:00:24, GigabitEthernet0/0</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>120.100.0.0/16 [90/2172416] via 120.100.123.1, 00:05:07, Serial0/0/0</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>120.100.1.0/24 [90/2297856] via 120.100.123.1, 00:05:07, Serial0/0/0</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>120.100.2.0/24 [90/2297856] via 120.100.123.2, 00:05:07, Serial0/0/0</td>
<td></td>
</tr>
<tr>
<td>D EX</td>
<td>120.100.63.0/24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[170/8780416] via 120.100.34.5, 00:00:24, GigabitEthernet0/0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[170/8780416] via 120.100.34.4, 00:00:24, GigabitEthernet0/0</td>
<td></td>
</tr>
<tr>
<td>D EX</td>
<td>120.100.53.0/24</td>
<td></td>
</tr>
</tbody>
</table>
Example 2-19  R4 and R5 Redistribution Configuration and Verification on R3  

```
[170/8780416] via 120.100.34.5, 00:00:24, GigabitEthernet0/0
[170/8780416] via 120.100.34.4, 00:00:24, GigabitEthernet0/0
D  EX  120.100.46.0/24
     [170/8780416] via 120.100.34.5, 00:00:24, GigabitEthernet0/0
     [170/8780416] via 120.100.34.4, 00:00:24, GigabitEthernet0/0
D  120.100.100.0/24 [90/2172416] via 120.100.123.1, 00:05:07, Serial0/0/0
D  120.100.200.0/24 [90/2172416] via 120.100.123.2, 00:05:08, Serial0/0/0
```

- R3 will have equal cost external EIGRP routes to the redistributed OSPF subnet 120.100.63.0/24 (VLAN63). Configure only R3 to ensure that R3 routes via a next hop of R5 (120.100.34.5) for this destination subnet. If this route fails, the route advertised from R4 (120.100.34.4) should be used dynamically. (3 points)

Example 2-20 shows both routes for 120.100.63.0/24 received on R3 from R4 and R5. Because all routers share a common media, the interface connecting to R4 or R5 cannot be modified on R3 because this would affect both routes. Similarly, an offset list to manipulate delay is of no use because you are permitted to configure R3 only. Therefore, you are required to penalize the route received from R4 only to ensure that the R5 generated route is preferred on R3. By configuring a route map on R3 to match only the route source of R4, you can increase the metric for the required route (120.100.63.0/24). This simply allows the original route received from R5 to take precedence.

Example 2-20 shows the required configuration and verification that the route is preferred via the R5. The topology table shows that the R4 route is also present and that R4 is effectively the feasible successor for this network on this router. If the route from R5 is withdrawn, the route from R5 enters the routing table automatically. You need a second permit statement on the route map (permit 20) to allow all other routes inbound to R3 to enter unaltered. Example 2-20 also details the routing tables of each device to confirm redistribution from EIGRP into OSPF or vice versa. If you have configured this correctly, as shown in Example 2-20, you have scored 3 points.
Example 2-20  R3 RIPv2 Redistribution Configuration and Verification

R3# show ip route 120.100.63.0
Routing entry for 120.100.63.0/24
Known via "eigrp 1", distance 170, metric 6780416, type external
Redistributing via eigrp 1
Last update from 120.100.34.5 on GigabitEthernet0/0, 00:01:59 ago
Routing Descriptor Blocks:
  120.100.34.5, from 120.100.34.5, 00:01:59 ago, via GigabitEthernet0/0
    Route metric is 6780416, traffic share count is 1
    Total delay is 200100 microseconds, minimum bandwidth is 1544 Kbit
    Reliability 255/255, minimum MTU 1500 bytes
    Loading 1/255, Hops 1
* 120.100.34.4, from 120.100.34.4, 00:01:59 ago, via GigabitEthernet0/0
    Route metric is 6780416, traffic share count is 1
    Total delay is 200100 microseconds, minimum bandwidth is 1544 Kbit
    Reliability 255/255, minimum MTU 1500 bytes
    Loading 1/255, Hops 1

R3(config)# access-list 1 permit 120.100.34.4
R3(config)# access-list 2 permit 120.100.63.0
R3(config)# router eigrp 1
R3(config-router)# distribute-list route-map PENALISE-VLAN63 in GigabitEthernet0/0
R3(config-router)# exit
R3(config)# route-map PENALISE-VLAN63 permit 10
R3(config-route-map)# match ip address 2
R3(config-route-map)# match ip route-source 1
R3(config-route-map)# set metric +500000
R3(config-route-map)# route-map PENALISE-VLAN63 permit 20
Example 2-20  R3 RIPv2 Redistribution Configuration and Verification  

R3# show ip route 120.100.63.0
Routing entry for 120.100.63.0/24
  Known via 'eigrp 1', distance 170, metric 6780416, type external
  Redistributing via eigrp 1
  Last update from 120.100.34.5 on GigabitEthernet0/0, 00:00:21 ago
  Routing Descriptor Blocks:
    * 120.100.34.5, from 120.100.34.5, 00:00:21 ago, via GigabitEthernet0/0
      Route metric is 6780416, traffic share count is 1
      Total delay is 200100 microseconds, minimum bandwidth is 1544 Kbit
      Reliability 255/255, minimum MTU 1500 bytes
      Loading 1/255, Hops 1

R3# show ip eigrp topology 120.100.63.0 255.255.255.0
IP-EIGRP (AS 1): Topology entry for 120.100.63.0/24
  State is Passive, Query origin flag is 1, 1 Successor(s), FD is 6780416
  Routing Descriptor Blocks:
    120.100.34.5 (GigabitEthernet0/0), from 120.100.34.5, Send flag is 0x0
      Composite metric is (6780416/6777856), Route is External
      Vector metric:
        Minimum bandwidth is 1544 Kbit
  Total delay is 200100 microseconds
    Reliability is 255/255
    Load is 1/255
    Minimum MTU is 1500
    Hop count is 1
    External data:
Example 2-20  R3 RIPv2 Redistribution Configuration and Verification
continued

Originating router is 120.100.5.1
AS number of route is 1
External protocol is OSPF, external metric is 2
Administrator tag is 0 (0x00000000)

120.100.34.4 (GigabitEthernet0/0), from 120.100.34.4, Send flag is 0x0
Composite metric is (120000000/6777855), Route is External
Vector metric:
  Minimum bandwidth is 20 Kbit
  Total delay is 0 micro seconds
  Reliability is 0/255
  Load is 0/255
  Minimum MTU is 0
  Hop count is 1

External data:
  Originating router is 120.100.4.1
  AS number of route is 1
  External protocol is OSPF, external metric is 2
  Administrator tag is 0 (0x00000000)
**Section 3: BGP (15 Points)**

- Configure Border Gateway Protocol (BGP) peering as per Figure 2-10 as follows: Internal Border Gateway Protocol (iBGP) R1-R3, R2-R3, R4-R6, R4-SW2, R5-Sw1, R5-sw3; External Border Gateway Protocol (eBGP) R3-R4, R3-R5, Sw4-Sw3, R6-Sw4. Use loopback interfaces to peer on all routers with the exception of peering between R3-R4 and R3-R5. Do not use the command `ebgp-multihop` within your configurations. (3 points)

The restrictions within the iBGP peering require you to configure R3, R4, and R5 as route reflectors within their own AS. Autosummarization is disabled to ensure that BGP does not summarize routes, and synchronization is disabled because the Interior Gateway Protocol (IGP) is not synchronized to BGP within this lab. The question doesn’t dictate that you must configure peer groups, but it is considered good practice where you have more than one peer with a similar peering configuration. However, the question does dictate that you must not use `ebgp-multihop`. Of course, this feature would be required for the peering from AS400 to AS300 and AS400 to AS200 because loopback interfaces are used for the external peering here, in contrast to AS100 to AS200 and AS300, which peer from connected interfaces. Without `ebgp-multihop` the peering fails in and outbound from AS400.

The only way to fix this is to use a feature that disables connection verification to establish an eBGP peering session with a single-hop peer that uses a loopback interface. If you use the command `neighbor disable-connected-check` on R6, Sw3, and Sw4 for the required peering, that allows you to form the peering successfully. Example 2-21 shows the basic peering configuration for BGP, the eBGP failure condition observed on peering to and from AS400, and the required configuration to rectify the condition. If you have configured this correctly, you have scored 3 points.

**Example 2-21  BGP Peering Configuration and Verification**

```plaintext
R1(config)# router bgp 100
R1(config-router)# no auto-summary
R1(config-router)# no synchronization
R1(config-router)# neighbor 120.100.3.1 remote-as 100
R1(config-router)# neighbor 120.100.3.1 update-source Loopback0
```
Example 2-21  BGP Peering Configuration and Verification  continued

R2(config)# router bgp 100
R2(config-router)# no auto-summary
R2(config-router)# no synchronization
R2(config-router)# neighbor 120.100.3.1 remote-as 100
R2(config-router)# neighbor 120.100.3.1 update-source Loopback0

R3(config)# router bgp 100
R3(config-router)# no auto-summary
R3(config-router)# no synchronization
R3(config-router)# neighbor AS100 peer-group
R3(config-router)# neighbor AS100 remote-as 100
R3(config-router)# neighbor AS100 update-source Loopback0
R3(config-router)# neighbor 120.100.1.1 peer-group AS100
R3(config-router)# neighbor 120.100.2.1 peer-group AS100
R3(config-router)# neighbor AS100 route-reflector-client
R3(config-router)# neighbor 120.100.34.4 remote-as 200
R3(config-router)# neighbor 120.100.34.5 remote-as 300

R4(config)# router bgp 200
R4(config-router)# router bgp 200
R4(config-router)# no auto-summary
R4(config-router)# no synchronization
R4(config-router)# neighbor AS200 peer-group
R4(config-router)# neighbor AS200 remote-as 200
R4(config-router)# neighbor AS200 update-source Loopback0
Example 2-21  BGP Peering Configuration and Verification  continued

R4(config-router)# neighbor AS200 route-reflector-client
R4(config-router)# neighbor 120.100.6.1 peer-group AS200
R4(config-router)# neighbor 120.100.8.1 peer-group AS200
R4(config-router)# neighbor 120.100.34.3 remote-as 100

R5(config)# router bgp 300
R6(config-router)# no auto-summary
R6(config-router)# no synchronization
R5(config-router)# neighbor AS300 peer-group
R6(config-router)# neighbor AS300 remote-as 300
R5(config-router)# neighbor AS300 update-source Loopback0
R6(config-router)# neighbor AS300 route-reflector-client
R5(config-router)# neighbor 120.100.7.1 peer-group AS300
R6(config-router)# neighbor 120.100.9.1 peer-group AS300
R6(config-router)# neighbor 120.100.34.3 remote-as 100

R6(config)# router bgp 200
R6(config-router)# no auto-summary
R6(config-router)# no synchronization
R6(config-router)# neighbor 120.100.4.1 remote-as 200
R6(config-router)# neighbor 120.100.4.1 update-source Loopback0
R6(config-router)# neighbor 120.100.10.1 remote-as 400
R6(config-router)# neighbor 120.100.10.1 update-source Loopback0

SW1(config)# router bgp 300
SW1(config-router)# no auto-summary
SW1(config-router)# no synchronization
Example 2-21  BGP Peering Configuration and Verification  continued

SW1(config-router)# neighbor 120.100.5.1 remote-as 300
SW1(config-router)# neighbor 120.100.5.1 update-source Loopback0

SW2(config)# router bgp 200
SW2(config-router)# no auto-summary
SW2(config-router)# no synchronization
SW2(config-router)# neighbor 120.100.4.1 remote-as 200
SW2(config-router)# neighbor 120.100.4.1 update-source Loopback0

SW3(config)# router bgp 300
SW3(config-router)# no auto-summary
SW3(config-router)# no synchronization
SW3(config-router)# neighbor 120.100.5.1 remote-as 300
SW3(config-router)# neighbor 120.100.5.1 update-source Loopback0
SW3(config-router)# neighbor 120.100.10.1 remote-as 400
SW3(config-router)# neighbor 120.100.10.1 update-source Loopback0

SW4(config)# router bgp 400
SW4(config-router)# no auto-summary
SW4(config-router)# no synchronization
SW4(config-router)# neighbor 120.100.6.1 remote-as 200
SW4(config-router)# neighbor 120.100.6.1 update-source Loopback0
SW4(config-router)# neighbor 120.100.9.1 remote-as 300
SW4(config-router)# neighbor 120.100.9.1 update-source Loopback0
Example 2-21  BGP Peering Configuration and Verification  continued

```plaintext
SW4# sh ip bgp neigh 120.100.6.1 | include External
  External BGP neighbor not directly connected.
SW4# show ip bgp neighbors 120.100.9.1 | include External
  External BGP neighbor not directly connected.
SW4#

SW4# sh ip bgp neighbors 120.100.6.1 | include active
  No active TCP connection
SW4# sh ip bgp neighbors 120.100.9.1 | include active
  No active TCP connection

SW4(config-router)# neighbor 120.100.6.1 disable-connected-check
SW4(config-router)# neighbor 120.100.9.1 disable-connected-check

R6(config-router)# neighbor 120.100.10.1 disable-connected-check

SW3(config-router)# neighbor 120.100.10.1 disable-connected-check

SW4# show ip bgp neighbors 120.100.6.1 | include Established
  BGP state = Established, up for 00:02:01
SW4# show ip bgp neighbors 120.100.9.1 | include Established
  BGP state = Established, up for 00:02:05
```

You also find peering issues between R1 and R3. Example 2-22 shows the routers are informing each other they have an incorrect BGP identifier. This is simply because both routers have identical loopback interface address of 200.200.200.200, which is used as the BGP identifier. By changing the ID of one router, you establish the peering. It doesn’t matter what you change the ID to, but it needs to be unique. As such, the loopback 0 interface is a good choice. No extra points for this task because this is part of the original peering.
Example 2-22  R1 and R3 Peering Issue Configuration and Verification

R1# 19:30:13.267: %BGP-3-NOTIFICATION: sent to neighbor 120.100.3.1 2/3 (BGP identifier wrong) 4 bytes 08C8C8C8

R3# 19:25:30.043: %BGP-3-NOTIFICATION: received from neighbor 120.100.1.1 2/3 (BGP identifier wrong) 4 bytes 08C8C8C8

R1# show ip bgp summary | include identifier
BGP router identifier 200.200.200.200, local AS number 100

R3# show ip bgp summary | include identifier
BGP router identifier 200.200.200.200, local AS number 100

R1(config-router)# bgp router-id 120.100.1.1
*19:34:45.467: %BGP-5-ADCHANGE: neighbor 120.100.3.1 Up

- Routers R1 and R2 in AS100 should be made to only passively accept BGP sessions. R3 should be configured to only actively create BGP sessions to R1 and R2 within AS100. (3 points)

By default a BGP speaker attempts to open a session on TCP port 179 with a configured peer. As such, a normal peering arrangement sees two sessions being established to build a successful neighbor relationship. This behavior can be modified to effectively allow sessions to be established only either inbound or outbound. The solution to the question is achieved by configuring the neighbor transport connection-mode to passive on R1 and R2 (inbound connections only are established) and active on R3 (outbound sessions only are established). You must manually activate each neighbor on each router for the solution to work effectively. If you have configured this correctly, as shown in Example 2-23, you have scored 3 points. Consider using the show ip bgp summary command to verify your configuration.
Example 2-23  R1, R2, and R3 Connection-Mode Configuration  

R1(config)# router bgp 100
R1(config-router)# neighbor 120.100.3.1 transport connection-mode passive
R1(config-router)# neighbor 120.100.3.1 activate

R2(config)# router bgp 100
R2(config-router)# neighbor 120.100.3.1 transport connection-mode passive
R2(config-router)# neighbor 120.100.3.1 activate

R3(config)# router bgp 100
R3(config-router)# neighbor AS100 transport connection-mode active
R3(config-router)# neighbor 120.100.1.1 activate
R3(config-router)# neighbor 120.100.2.1 activate

Configure the following loopback interfaces on R3 and Sw4. Advertise these networks into BGP using the network command: (2 points)

R3 - Loopback interface 5 (152.100.100.1/24)
Sw4 - Loopback interface 5 (152.200.32.1/24)
Sw4 - Loopback interface 6 (152.200.33.1/24)
Sw4 - Loopback interface 7 (152.200.34.1/24)
Sw4 - Loopback interface 8 (152.200.35.1/24)

This is a simple question that creates BGP routes for the following task. If you have configured this correctly, as shown in Example 2-24, you have scored 2 points.
Example 2-24  R3 and Sw4 Network Advertisement Configuration and Verification

R3(config)# interface Loopback5
R3(config-if)# ip address 152.100.100.1 255.255.255.0
R3(config-if)# router bgp 100
R3(config-router)# network 152.100.100.0 mask 255.255.255.0

Sw4(config)# interface Loopback5
Sw4(config-if)# ip address 152.200.32.1 255.255.255.0
Sw4(config-if)# interface Loopback6
Sw4(config-if)# ip address 152.200.33.1 255.255.255.0
Sw4(config-if)# interface Loopback7
Sw4(config-if)# ip address 152.200.34.1 255.255.255.0
Sw4(config-if)# interface Loopback8
Sw4(config-if)# ip address 152.200.35.1 255.255.255.0
Sw4(config-if)# router bgp 400
Sw4(config-router)# network 152.200.32.0 mask 255.255.255.0
Sw4(config-router)# network 152.200.33.0 mask 255.255.255.0
Sw4(config-router)# network 152.200.34.0 mask 255.255.255.0
Sw4(config-router)# network 152.200.35.0 mask 255.255.255.0

R3# show ip bgp
BGP table version is 10, local router ID is 200.200.200.200
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
               r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
Example 2-24  R3 and Sw4 Network Advertisement Configuration and Verification  

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
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<tr>
<td>*&gt; 152.100.100.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td>32768</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>* 152.200.32.0/24</td>
<td>120.100.34.4</td>
<td>0</td>
<td>200</td>
<td>400</td>
<td>i</td>
</tr>
<tr>
<td>*&gt; 120.100.34.5</td>
<td>120.100.34.5</td>
<td>0</td>
<td>300</td>
<td>400</td>
<td>i</td>
</tr>
<tr>
<td>* 152.200.33.0/24</td>
<td>120.100.34.4</td>
<td>0</td>
<td>200</td>
<td>400</td>
<td>i</td>
</tr>
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<td>120.100.34.5</td>
<td>0</td>
<td>300</td>
<td>400</td>
<td>i</td>
</tr>
<tr>
<td>* 152.200.34.0/24</td>
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<td>0</td>
<td>200</td>
<td>400</td>
<td>i</td>
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<td>300</td>
<td>400</td>
<td>i</td>
</tr>
<tr>
<td>* 152.200.35.0/24</td>
<td>120.100.34.4</td>
<td>0</td>
<td>200</td>
<td>400</td>
<td>i</td>
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<tr>
<td>*&gt; 120.100.34.5</td>
<td>120.100.34.5</td>
<td>0</td>
<td>300</td>
<td>400</td>
<td>i</td>
</tr>
</tbody>
</table>

- Configure R3 to inform R4 that it does not want to receive routes advertised from Sw4 for networks 152.200.33.0/24, 152.200.34.0/24, and 152.200.35.0/24. Achieve this in such a manner that R4 does not actually advertise these routes toward R3. You can also configure R4. (4 points)

BGP has a prefix-based Outbound Route Filtering (ORF) mechanism that sends and receives capabilities to minimize BGP updates sent between BGP peers. Advertisement of ORF capability indicates that a peer accepts a prefix list from a neighbor and applies the prefix list received from a neighbor locally to avoid the unnecessary sending of routes that would be blocked by the receiver anyway. Therefore, R3 is configured with a prefix list that blocks the required routes generated from Sw4 and that is sent via ORF to R4. R4 is configured to receive this prefix list via ORF, and the routes are blocked outbound at R4. Example 2-25 shows the required ORF and prefix list filtering with the resulting outbound advertisement on R4. The BGP table on R3 is also displayed, showing the routes are no longer being received from R4 and instead are being received solely from R5. If you have configured this correctly, as shown in Example 2-25, you have scored 4 points.
Example 2-25 BGP ORF Configuration and Verification

R3(config)# router bgp 100
R3(config-router)# neighbor 120.100.34.4 capability orf prefix-list send
R3(config-router)# neighbor 120.100.34.4 prefix-list FILTER in
R3(config)# ip prefix-list FILTER seq 5 deny 152.200.33.0/24
R3(config)# ip prefix-list FILTER seq 10 deny 152.200.34.0/24
R3(config)# ip prefix-list FILTER seq 15 deny 152.200.35.0/24
R3(config)# ip prefix-list FILTER seq 20 permit 0.0.0.0/0 le 32

R4(config)# router bgp 200
R4(config-router)# neighbor 120.100.34.3 capability orf prefix-list receive
R4(config-router)# exit
R4(config)# exit
R4# show ip bgp neighbors 120.100.34.3 advertised-routes
BGP table version is 17, local router ID is 120.100.4.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
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<td>100</td>
<td>0 400</td>
<td>i</td>
</tr>
</tbody>
</table>

Total number of prefixes 1

R3# clear ip bgp *
R3# show ip bgp
BGP table version is 6, local router ID is 200.200.200.200
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Example 2-25  BGP ORF Configuration and Verification  continued

Origin codes:  i - IGP,  e - EGP,  ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
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<td>0</td>
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<tr>
<td>152.200.32.0/24 120.100.34.4</td>
<td></td>
<td>0</td>
<td>200</td>
<td>400</td>
<td>i</td>
</tr>
<tr>
<td>120.100.34.5</td>
<td></td>
<td>0</td>
<td>300</td>
<td>400</td>
<td>i</td>
</tr>
<tr>
<td>152.200.33.0/24 120.100.34.5</td>
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<td>0</td>
<td>300</td>
<td>400</td>
<td>i</td>
</tr>
<tr>
<td>152.200.34.0/24 120.100.34.5</td>
<td></td>
<td>0</td>
<td>300</td>
<td>400</td>
<td>i</td>
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<tr>
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<td></td>
<td>0</td>
<td>300</td>
<td>400</td>
<td>i</td>
</tr>
</tbody>
</table>

Configure a route map on R5 that prepends its local AS 2 an additional two times for network 152.200.32.0/24 when advertised to R3. The route map can contain multiple permit statements, but only one prepend is permitted per line. (3 points)

This is a simple AS path prepend question, or so it seems. Normally, you prepend the same AS number multiple times within the same permit statement, but the question restricts this so that you are forced to use multiple permit statements with the same AS prepend statement. Example 2-26 shows the route 152.200.32.0/24 as received initially on R3 from R5 with an AS path of 300-400. After configuration of the route map to prepend the route on R5 twice, the network is received on R3 with an AS path of 300-300-400. This might look like the route has indeed been prepended twice, but the question requests an “additional” two times. In fact, the route has been prepended only once.

The problem is that the route-map permit 10 statement on R3 has been executed, and the route map then does not evaluate any additional route map entries and simply drops out so that the permit 20 statement is never actually executed. By configuring a continue 20 statement within the permit 10 line, the router is forced to evaluate the permit 20 line rather than dropping out of the route map after successful execution of the permit 10 statement. The final verification in Example 2-26 shows the route received on R3 with successful prepend applied by R5. If you have configured this correctly, as shown in Example 2-26, you have scored 3 points.
Example 2-26  R5 Prepend Configuration and Verification

R3# show ip bgp
BGP table version is 6, local router ID is 200.200.200.200
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*-&gt; 152.100.100.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td>32768</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>*-&gt; 152.200.32.0/24</td>
<td>120.100.34.4</td>
<td>0</td>
<td>200 400</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>*</td>
<td>120.100.34.5</td>
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<td>300 400</td>
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<td>*-&gt; 152.200.33.0/24</td>
<td>120.100.34.5</td>
<td>0</td>
<td>300 400</td>
<td>i</td>
<td></td>
</tr>
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<td>*-&gt; 152.200.34.0/24</td>
<td>120.100.34.5</td>
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<td>i</td>
<td></td>
</tr>
<tr>
<td>*-&gt; 152.200.35.0/24</td>
<td>120.100.34.5</td>
<td>0</td>
<td>300 400</td>
<td>i</td>
<td></td>
</tr>
</tbody>
</table>

R5(config)# router bgp 300
R5(config-router)# neighbor 120.100.34.3 route-map PREPEND out
R5(config-router)# exit
R5(config)# access-list 1 permit 152.200.32.0
R5(config)# route-map PREPEND permit 10
R5(config-route-map)# match ip address 1
R5(config-route-map)# set as-path prepend 300
R5(config-route-map)# route-map PREPEND permit 20
R5(config-route-map)# match ip address 1
R5(config-route-map)# set as-path prepend 300
R5(config-route-map)# route-map PREPEND permit 30
**Example 2-26  R5 Prepend Configuration and Verification  continued**

R3# show ip bgp

BGP table version is 6, local router ID is 200.200.200.200

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal, 
r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
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<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
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<tbody>
<tr>
<td>* 152.100.100.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td>32768  i</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* 152.200.32.0/24</td>
<td>120.100.34.4</td>
<td>0</td>
<td>200  400 i</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*</td>
<td>120.100.34.5</td>
<td>0</td>
<td>300  300 400 i</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* 152.200.33.0/24</td>
<td>120.100.34.5</td>
<td>0</td>
<td>300  400 i</td>
<td></td>
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</tr>
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<td>* 152.200.34.0/24</td>
<td>120.100.34.5</td>
<td>0</td>
<td>300  400 i</td>
<td></td>
<td></td>
</tr>
<tr>
<td>* 152.200.35.0/24</td>
<td>120.100.34.5</td>
<td>0</td>
<td>300  400 i</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R5(config)# route-map PREPEND permit 10
R5(config-route-map)# continue 20

R3# clear ip bgp *
R3# show ip bgp

BGP table version is 6, local router ID is 200.200.200.200

Status codes: s suppressed, d damped, h history, * valid, > best, i - internal, 
r RIB-failure, S Stale

Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
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<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
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<tbody>
<tr>
<td>* 152.100.100.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td>32768  i</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Section 4: IPv6 (12 Points)

- Configure IPv6 addresses on your network as follows:
  2007:C15:C0:10::1/64 - R1 Gi0/0
  2007:C15:C0:11::1/64 - R1 tunnel0
  2007:C15:C0:11::3/64 - R3 tunnel0
  2007:C15:C0:12::2/64 - R2 tunnel0
  2007:C15:C0:12::3/64 - R3 tunnel1
  2007:C15:C0:13::2/64 - R2 fe0/1
  2007:C15:C0:14::3/64 - R3 Gi0/0
  2007:C15:C0:14::4/64 - R4 Gi0/0
  2007:C15:C0:14::5/64 - R5 Gi0/0
  2007:C15:C0:15::5/64 - R4 Gi0/1
  2007:C15:C0:15::6/64 - R6 Gi0/0
The prerequisite to the following questions is configuration of the IPv6 addresses and tunnel interfaces. You should test your IPv6 connectivity post-configuration to ensure that you are ready to progress to the routing questions. You do not need Frame Relay maps to achieve connectivity because tunneling is required rather than IPv6 directly configured under the serial interfaces on R1, R2, and R3. Example 2-27 shows the initial IPv6 configuration. Tunnel specifics are provided in later questions, so just creating the tunnel interfaces and configuring an IPv6 address is required at this point. No points on offer here for this task, unfortunately. Consider using the show ipv6 interfaces brief command for a quick check of your interface configuration.

**Example 2-27   IPv6 Initial Configuration**

R1(config)# ipv6 unicast-routing
R1(config)# interface GigabitEthernet0/1
R1(config-if)# ipv6 address 2007:C15:C0:10::1/64
R1(config-if)# interface tunnel0
R1(config-if)# ipv6 address 2007:C15:C0:11::1/64

R2(config)# ipv6 unicast-routing
R2(config)# interface FastEthernet 0/1
R2(config-if)# ipv6 address 2007:C15:C0:13::2/64
R2(config-if)# interface tunnel0
R2(config-if)# ipv6 address 2007:C15:C0:12::2/64

R3(config)# ipv6 unicast-routing
R3(config)# int GigabitEthernet0/0
R3(config-if)# ipv6 address 2007:C15:C0:14::3/64
R3(config-if)# interface tunnel0
R3(config-if)# ipv6 address 2007:C15:C0:11::3/64

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Example 2-27  IPv6 Initial Configuration  continued

R3(config-if)# interface tunnel1
R3(config-if)# ipv6 address 2007:C15:C0:12::3/64

R4(config)# ipv6 unicast-routing
R4(config)# interface GigabitEthernet0/0
R4(config-if)# ipv6 address 2007:C15:C0:14::4/64
R4(config-if)# interface GigabitEthernet0/1
R4(config-if)# ipv6 address 2007:C15:C0:15::4/64

R5(config)# ipv6 unicast-routing
R5(config)# interface GigabitEthernet0/0
R5(config-if)# ipv6 address 2007:C15:C0:14::5/64

R6(config)# ipv6 unicast-routing
R6(config)# interface GigabitEthernet0/0
R6(config-if)# ipv6 address 2007:C15:C0:15::6/64

Section 4.1: RIPng

- Configure Routing Information Protocol next generation (RIPng) among R1, R2, and R3 per Figure 2-11. RIPng should be enabled on the Ethernet interfaces of R1 and R2 and on all tunnel interfaces of R1, R2, and R3. Build your tunnels using ipv6ip mode; use an RIP process of CCIE on all required interfaces. (2 points)
This is a straightforward RIPng configuration that requires the process of CCIE applied to the required interfaces. The tunnel mode information, ipv6ip for a manually configured IPv6 tunnel, is supplied within this question. If you have configured this correctly, as shown in Example 2-28, you have scored 2 points.

**Example 2-28  RIPng Configuration and Verification**

```
R1(config)# interface GigabitEthernet 0/1
R1(config-if)# ipv6 rip CCIE enable
R1(config-if)# interface Tunnel0
R1(config-if)# ipv6 rip CCIE enable
R1(config-if)# tunnel source Serial0/0/0
R1(config-if)# tunnel destination 120.100.123.3
R1(config-if)# tunnel mode ipv6ip

R2(config)# interface FastEthernet 0/1
R2(config-if)# ipv6 rip CCIE enable
R2(config-if)# interface Tunnel0
R2(config-if)# ipv6 rip CCIE enable
R2(config-if)# tunnel source Serial0/0
R2(config-if)# tunnel destination 120.100.123.3
R2(config-if)# tunnel mode ipv6ip

R3(config)# interface Tunnel0
R3(config-if)# ipv6 rip CCIE enable
R3(config-if)# tunnel source Serial0/0/0
R3(config-if)# tunnel destination 120.100.123.1
R3(config-if)# tunnel mode ipv6ip
R3(config-if)# interface Tunnel1
R3(config-if)# ipv6 rip CCIE enable
```
Example 2-28  RIPng Configuration and Verification  continued

R3(config-if)# tunnel source Serial0/0/0
R3(config-if)# tunnel destination 120.100.123.2
R3(config-if)# tunnel mode ipv6ip

R1# show ipv6 route rip
IPv6 Routing Table - 8 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
        U - Per-user Static route
        I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
        O - OSPF intra, OI - OSPF inter, O/E1 - OSPF ext 1, O/E2 - OSPF ext 2
        O/N1 - OSPF NSSA ext 1, O/N2 - OSPF NSSA ext 2
        D - EIGRP, EX - EIGRP external

R  2007:C15:0:12::/64 [120/2]
   via FE00::7864:7B03, Tunnel0

R  2007:C15:0:13::/64 [120/3]
   via FE00::7864:7B03, Tunnel0

R2# show ipv6 route rip
IPv6 Routing Table - 8 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
        U - Per-user Static route
        I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
        O - OSPF intra, OI - OSPF inter, O/E1 - OSPF ext 1, O/E2 - OSPF ext 2
        O/N1 - OSPF NSSA ext 1, O/N2 - OSPF NSSA ext 2
        D - EIGRP, EX - EIGRP external

R  2007:C15:0:10::/64 [120/3]
Example 2-28  RIPng Configuration and Verification  continued

via FE00::7864:7B03, Tunnel0
R 2007:C15::C0:11::/64 [120/2]
   via FE00::7864:7B03, Tunnel0

R3# show ipv6 route rip
IPv6 Routing Table - 11 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
   U - Per-user Static route
   I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
   O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
   ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
   D - EIGRP, EX - EIGRP external
R 2007:C15::C0:10::/64 [120/2]
   via FE00::7864:7B01, Tunnel0
R 2007:C15::C0:13::/64 [120/2]
   via FE00::7864:7B02, Tunnel1

Section 4.2: OSPFv3

- Configure OSPFv3 as per Figure 2-11. Use an OSPFv3 process of 1 on each router. (2 points)

This is a vanilla OSPFv3 configuration among R3, R4, R5, and R6. If you have configured this correctly, as shown in Example 2-29, you have scored 2 points.
Example 2-29  OSPFv3 Configuration and Verification

R3(config)# interface GigabitEthernet 0/0
R3(config-if)# ipv6 ospf 1 area 0

R4(config)# interface GigabitEthernet0/0
R4(config-if)# ipv6 ospf 1 area 0
R4(config-if)# interface GigabitEthernet0/1
R4(config-if)# ipv6 ospf 1 area 1

R5(config)# interface GigabitEthernet0/0
R5(config-if)# ipv6 ospf 1 area 0

R6(config)# interface GigabitEthernet0/0
R6(config-if)# ipv6 ospf 1 area 1

R3# show ipv6 route ospf
IPv6 Routing Table - 11 entries
Codes:  C - Connected, L - Local, S - Static, R - RIP, B - BGP
        U - Per-user Static route
        D - Direct, O - Other, IA - OSPF interarea, OI - OSPF external type 1
        OI1 - OSPF external type 1, O2 - OSPF external type 2
        ON1 - OSPF NSSA external type 1, OIA - OSPF NSSA external type 2
        *D - EIGRP, EX - EIGRP external

OIA 2007:C15:0:0:15::/64 [110/2]
    via FE80::213:C3FF:FE7B:E4A0, GigabitEthernet0/0

R5# show ipv6 route ospf
IPv6 Routing Table - 5 entries
The OSPFv3 routing table of R4 is not shown in Example 2-29 because this router physically connects to each IPv6 network and as such does not discover any OSPFv3 dynamic routes at this point in time.

**Example 2-29  OSPFv3 Configuration and Verification  continued**

   Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
             U - Per-user Static route
              I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
         0 - OSPF intra, 0I - OSPF inter, 0E1 - OSPF ext 1, 0E2 - OSPF ext 2
      O1N1 - OSPF NSSA ext 1, O1N2 - OSPF NSSA ext 2
      D - EIGRP, EX - EIGRP external

| 0I 2007:C15:C0:15::/64 [110/2] |
|---------------------------------
| via FE80::213:C3FF:FE7B:E4A0, GigabitEthernet0/0 |

R6# show ipv6 route ospf
IPv6 Routing Table - 5 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
             U - Per-user Static route
              I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
         0 - OSPF intra, 0I - OSPF inter, 0E1 - OSPF ext 1, 0E2 - OSPF ext 2
      O1N1 - OSPF NSSA ext 1, O1N2 - OSPF NSSA ext 2
     OI 2007:C15:C0:14::/64 [110/2] |
|---------------------------------
| via FE80::213:C3FF:FE7B:E4A1, GigabitEthernet0/0 |

Configure area 1 with IPsec authentication, use message digest message digest algorithm 5 (MD5), a Security Policy Index of 500, and a key of DEC0DECC1E0DDBA11B0BB0BBEDB00B00. (2 points)

Authentication is required on R4 and R6 because they both belong to area 1. The question explicitly states the specific parameters required, and you shouldn’t encounter any issues other than if you incorrectly enter one of the keys. At 32 hex characters long, this could easily be done while under a time constraint. If you have configured this correctly, as shown in Example 2-30, you have scored 2 points.
Example 2-30  Area 1 Authentication Configuration

R4(config)# ipv6 router ospf 1
R4(config-router)# area 1 authentication ipsec spi 500 md5 DEC0DECC1E0DDBA11B0BB0BBEDB00B00

R6(config)# ipv6 router ospf 1
R6(config-router)# area 1 authentication ipsec spi 500 md5 DEC0DECC1E0DDBA11B0BB0BBEDB00B00

Ensure that the area router in area 1 receives the following route; you can configure R4 to achieve this. (2 points)

OI  2007::/16 [110/2]
  via XXXX::XXXX:XXXX:XXXX:XXXX, GigabitEthernet0/0

The only area router within area 1 is R6. R4 is the area border router within this area. OI within the routing table is an OSPF Interarea route, so this route must be generated from another area. Because area 0 is the only other area within the OSPFv3 network, the route must be generated from this area as opposed to a redistributed route, which would show as an external route. A summary route generated on the area border router R4 of 2007::/16 within area 0 provides the required route to be received on R6. If you have configured this correctly, as shown in Example 2-31, you have scored 2 points.

Example 2-31  OSPFv3 Configuration and Verification

R4(config)# ipv6 router ospf 1
R4(config-rtr)# area 0 range 2007::/16

R6#show ipv6 route ospf 1 include OI

OI  2007::/16 [110/2]
  via FE80::213:C3FF:FE7B:E4A1, GigabitEthernet0/0
Section 4.3: Redistribution

Redistribute RIPng into OSPFv3 on R3. Redistributed RIPng routes should have a metric of 5000 associated with them regardless of which area they are seen in within the OSPFv3 network. (2 points)

A one-way redistribution of RIPng to OSPFv3 is required on R3. The default redistribution behavior ensures that external routes are advertised as external type 2, which have a fixed cost associated with them, regardless of which area or location of the OSPFv3 network they are seen in. You simply need the metric set to 5000 on the OSPFv3 process. You must remember to advertise connected routes also; otherwise, the OSPFv3 network does not see the directly connected tunnel interfaces on R3. If you have configured this correctly, as shown in Example 2-32, you have scored 2 points.

Example 2-32  R3 IPv6 Redistribution Configuration and Verification

R3(config)# ipv6 router ospf 1
R3(config-router)# redistribute rip ccie include-connected metric 5000

R4# show ipv6 route ospf
IPv6 Routing Table - 11 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
    U - Per-user Static route
    I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
    O - OSPF intra, O1 - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
    ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
    D - EIGRP, EX - EIGRP external
0 2007::/16  [110/0]
    via ::, Null0
0E2 2007:0:10:4::/64  [110/5000]
    via FE80::214:AFF:FEFC:7390, GigabitEthernet0/0

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Example 2-32  R3 IPv6 Redistribution Configuration and Verification  continued

<table>
<thead>
<tr>
<th>0E2</th>
<th>2007:C15:C0:11::/64 [110/5000]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0E2</th>
<th>2007:C15:C0:12::/64 [110/5000]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>0E2</th>
<th>2007:C15:C0:13::/64 [110/5000]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0</td>
</tr>
</tbody>
</table>

Configure R3 so that both R1 and R2 have the following IPv6 RIPng route in place. Do not redistribute OSPF into RIPng to achieve this and ensure that all routers have full visibility. (2 points)

R  2007::/16 [120/2]
    via XXXX::XXXX:XXXX:XXXX:XXXX:10, Tunnel0

You should have noticed in the previous question that mutual redistribution was not required. As such, the RIPng network does not have reachability of the OSPFv3 network. This question ensures that the RIPng network sends traffic to R3 for the summarized network of 2007::/16. Because you are not permitted to redistribute OSPFv3 with a summary address, you must configure RIPng summarization on the tunnel interfaces on R3 toward R1 and R2. This provides the correct route and hop count as per the question. Example 2-33 shows the required configuration and verification of the route in addition to ICMP reachability to the remote OSPFv3 area 1 network on R6. This test clearly demonstrates full end-to-end reachability from RIPng to OSPFv3. If you have configured this correctly, as shown in Example 2-33, you have scored 2 points.
Example 2-33  R3 IPv6 Summarization Configuration and Verification

R3(config)# interface tunnel 0
R3(config-if)# ipv6 rip CCIE summary-address 2007::/16
R3(config-if)# interface tunnel 1
R3(config-if)# ipv6 rip CCIE summary-address 2007::/16

R1# show ipv6 route rip
IPv6 Routing Table - 7 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
    U - Per-user Static route
    I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
    O - OSPF intra, O1 - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
    ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
    D - EIGRP, EX - EIGRP external

  R  2007::/16 [120/2]
      via FE80::7864:7B03, Tunnel0

R1# ping ipv6 2007:C15:C0:15::6

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2007:C15:C0:15::6, timeout is 2 seconds:
!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/7/8 ms

R2# show ipv6 route rip
IPv6 Routing Table - 7 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
    U - Per-user Static route
    I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
Example 2-33  R3 IPv6 Summarization Configuration and Verification  

```
  0 - OSPF intra, 01 - OSPF inter, 0E1 - OSPF ext 1, 0E2 - OSPF ext 2
  ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
  D - EIGRP, EX - EIGRP external

R  2007::/16 [120/2]
    via FE80::7864:7B03, Tunnel0

R2# ping ipv6 2007:C15:0:15::6

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2007:C15:0:15::6, timeout is 2 seconds:
   !!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/7/8 ms
```

Section 5: QoS (6 Points)

- Two IP videoconferencing units are to be installed onto switch 2 ports FastEthernet 0/15 and 0/16 on VLAN200. The devices use TCP ports 3230–3231 and User Datagram Protocol (UDP) ports 3230–3235, and this traffic is unmarked from the devices as it enters the switch. Configure switch 2 to assign a Differentiated Services Code Point (DSCP) value of AF41 to video traffic from both of these devices. Ensure that the switch ports assigned to the devices do not participate in the usual spanning-tree checks, cannot form trunk links, and cannot be configured as EtherChannels. (3 points)

This is a DSCP coloring of an application traffic question. The TCP and UDP port information is provided so that access lists matching these ports within a class map are required for identification of the video traffic and a policy map colors the traffic to a DSCP value of 41. The overall QoS service policy is applied to the videoconferencing ports of FastEthernet...
0/15 and 0/16 on switch 2. The ports are required to be set to VLAN200 with spanning-tree checks disabled, and trunking and channeling disabled using the command `switchport host`. The ports can also be explicitly configured to disable each feature individually, but the `switchport host` command does all this for you. If you have configured this correctly, as shown in Example 2-34, you have scored 3 points. Use the `show policy-map` command to verify your configuration.

Example 2-34  OSPFv3 Configuration

```
SW2(config)# interface range fastEthernet 0/15-16
SW2(config-if-range)# switchport access vlan 200
SW2(config-if-range)# switchport host
SW2(config-if-range)# exit
SW2(config)# mls qos
SW2(config)# class-map VIDEO
SW2(config-cmap)# match access-group 100
SW2(config-cmap)# exit
SW2(config)# access-list 100 permit tcp any any range 3230 3231
SW2(config)# access-list 100 permit udp any any range 3230 3235
SW2(config)# policy-map VIDEO-MARK
SW2(config-pmap)# class VIDEO
SW2(config-pmap-c)# set dscp AF41
SW2(config-pmap-c)# exit
SW2(config)# interface range fastEthernet 0/15-16
SW2(config-if-range)# service-policy input VIDEO-MARK
```

Configure R2 to assign a strict priority queue with a 40 percent reservation of the WAN bandwidth for the videoconferencing traffic in the previous question. Maximize the available bandwidth by ensuring the real-time protocol (RTP) headers within the video stream are compressed. The remainder of the bandwidth should be guaranteed for a default queue with Weighted Random Early Detection (WRED) enabled. Assume that the full line rate of 1.544 Mbps is the available WAN bandwidth, and ensure that the complete bandwidth is utilized by both queues. (3 points)
Following from the previous question, R2 is required to provide QoS on the Frame Relay link. A class map matches the precolored video traffic of DSCP 41. You then need a policy map to call the class map and assign a strict 40 percent priority queue with the command priority percent 40. RTP compression is configured within the policy map for the video traffic. The default queue has a guaranteed bandwidth reservation with the command bandwidth percent 60, and WRED is enabled within this queue. Both queues are able to use the full bandwidth of the WAN link only if the command max-reserved-bandwidth 100 is configured under the Frame Relay interface. Otherwise, only 75 percent of available bandwidth is used by default. If you have configured this correctly, as shown in Example 2-35, you have scored 3 points.

Example 2-35  R2 QoS Configuration and Verification

R2(config)# class-map match-all VIDEO
R2(config-cmap)# match dscp af41
R2(config-cmap)# policy-map VIDEO-QOS
R2(config-pmap)# class VIDEO
R2(config-pmap-c)# priority percent 40
R2(config-pmap-c)# compress header ip rtp
R2(config-pmap-c)# class class-default
R2(config-pmap-c)# bandwidth percent 60
R2(config-pmap-c)# random-detected
R2(config-pmap-c)# exit
R2(config)# interface Serial0/0
R2(config-if)# max-reserved-bandwidth 100
R2(config-if)# service-policy output VIDEO-QOS
Section 6: Multicast (7 Points)

- Configure routers R1, R2, R3, and R4 for IPv4 Multicast. Each router should use PIM sparse dense mode. Both R1 and R2 should be configured to be Candidate Rendezvous Points (RP) specifically for the following multicast groups 225.225.0.1, 225.225.0.2, 225.225.0.3, and 225.225.0.4 by use of their loopback 0 interfaces. You should limit the boundary of your multicast network so that it does not propagate further into your network than R4. R3 should be configured as a mapping agent to announce the Rendezvous Points for the multicast network with the same boundary constraints. (3 points)

The question dictates that R1 and R2 be rendezvous points and advertise the same groups to the multicast network. R3 is required to announce the rendezvous points, and R4 by default elects R2 as the RP for each group because it has the higher loopback address compared to R1 for the same groups. TTL scoping is used within the configuration to limit the boundary of advertisements on both the candidate RPs and the discovery agent up to R4. Example 2-36 shows the required configuration and RP mappings as received on R4. If you have configured this correctly, as shown in Example 2-36, you have scored 3 points.

Example 2-36  R1, R2, R3, and R4 Multicast Configuration and Verification

```plaintext
R1(config)# ip multicast-routing
R1(config)# interface Loopback0
R1(config-if)# ip pim sparse-dense-mode
R1(config-if)# interface Serial0/0/0
R1(config-if)# ip pim sparse-dense-mode
R1(config-if)# ip pim send-rp-announce Loopback0 scope 3 group-list GROUPS
R1(config)# ip access-list standard GROUPS
R1(config-standard-nacl)# permit 225.225.0.1
R1(config-standard-nacl)# permit 225.225.0.2
R1(config-standard-nacl)# permit 225.225.0.3
R1(config-standard-nacl)# permit 225.225.0.4
```
Example 2-36 R1, R2, R3, and R4 Multicast Configuration and Verification

R2(config)# ip multicast-routing
R2(config)# interface Loopback0
R2(config-if)# ip pim sparse-dense-mode
R2(config-if)# interface Serial0/0
R2(config-if)# ip pim sparse-dense-mode
R2(config-if)# ip pim send-rp-announce Loopback0 scope 3 group-list GROUPS
R2(config)# ip access-list standard GROUPS
R2(config-std-nacl)# permit 225.225.0.1
R2(config-std-nacl)# permit 225.225.0.2
R2(config-std-nacl)# permit 225.225.0.3
R2(config-std-nacl)# permit 225.225.0.4

R3(config)# ip multicast-routing
R3(config)# interface Loopback0
R3(config-if)# ip pim sparse-dense-mode
R3(config)# interface GigabitEthernet0/0
R3(config-if)# ip pim sparse-dense-mode
R3(config-if)# interface Serial0/0/0
R3(config-if)# ip pim sparse-dense-mode
R3(config-if)# exit
R3(config)# ip pim send-rp-discovery lo0 scope 2
R4(config-if)# ip multicast-routing
R4(config-if)# interface GigabitEthernet0/0
R4(config-if)# ip pim sparse-dense-mode

R4# show ip pim rp mapping
PIM Group-to-RP Mappings
Example 2-36  R1, R2, R3, and R4 Multicast Configuration and Verification  continued

Group(s) 225.225.0.1/32
  RP 120.100.2.1 (??), v2v1
    Info source: 120.100.34.3 (?), elected via Auto-RP
    Uptime: 00:00:03, expires: 00:02:52

Group(s) 225.225.0.2/32
  RP 120.100.2.1 (??), v2v1
    Info source: 120.100.34.3 (?), elected via Auto-RP
    Uptime: 00:00:03, expires: 00:02:56

Group(s) 225.225.0.3/32
  RP 120.100.2.1 (??), v2v1
    Info source: 120.100.34.3 (?), elected via Auto-RP
    Uptime: 00:00:03, expires: 00:02:55

Group(s) 225.225.0.4/32
  RP 120.100.2.1 (??), v2v1
    Info source: 120.100.34.3 (?), elected via Auto-RP
    Uptime: 00:00:03, expires: 00:02:55

- Configure R3 to ensure that R4 has a Candidate RP as R1 for groups 225.225.0.1 and 225.225.0.2 and R2 for groups 225.225.0.3 and 225.225.0.4. (2 points)

As detailed in the previous example, R2 becomes by default the candidate RP as selected by the discovery agent (R3) because of having a higher loopback IP address as used in the PIM announcements compared to R1. By configuring a group list on the discovery agent, you can filter RP announcements. By configuring two filter lists with each candidate RP associated to them, you allow the discovery agent to announce two different RPs. Example 2-37 shows the required configuration, a debug of the auto-rp announcements on R3 to detail the filtering, and the resulting RP mappings on R4. If you have configured this correctly, as shown in Example 2-37, you have scored 2 points.
Example 2-37  R2 QoS Configuration and Verification

R3(config)# ip pim rp-announce-filter rp-list R1 group-list R1-GROUPS
R3(config)# ip pim rp-announce-filter rp-list R2 group-list R2-GROUPS
R3(config)# ip access-list standard R1
R3(config-standard-nacl)# permit 120.100.1.1
R3(config-standard-nacl)# exit
R3(config)# ip access-list standard R2
R3(config-standard-nacl)# permit 120.100.2.1
R3(config-standard-nacl)# exit
R3(config)# ip access-list standard R1-GROUPS
R3(config-standard-nacl)# permit 225.225.0.1
R3(config-standard-nacl)# permit 225.225.0.2
R3(config-standard-nacl)# exit
R3(config)# ip access-list standard R2-GROUPS
R3(config-standard-nacl)# permit 225.225.0.3
R3(config-standard-nacl)# permit 225.225.0.4

R3# debug ip pim auto-rp
PIM Auto-RP debugging is on
Auto-RP(0): Received RP-announce, from 120.100.1.1, RP_cnt 1, ht 181
Auto-RP(0): Update (225.225.0.1/32, RP:120.100.1.1), PIMv2 v1
Auto-RP(0): Update (225.225.0.2/32, RP:120.100.1.1), PIMv2 v1
Auto-RP(0): Filtered 225.225.0.3/32 for RP 120.100.1.1
Auto-RP(0): Filtered 225.225.0.4/32 for RP 120.100.1.1
Auto-RP(0): Received RP-announce, from 120.100.1.1, RP_cnt 1, ht 181
Auto-RP(0): Update (225.225.0.1/32, RP:120.100.1.1), PIMv2 v1
Auto-RP(0): Update (225.225.0.2/32, RP:120.100.1.1), PIMv2 v1
Auto-RP(0): Filtered 225.225.0.3/32 for RP 120.100.1.1
Example 2-37  R2 QoS Configuration and Verification  

Auto-RP(0): Filtered 225.225.0.4/32 for RP 120.100.1.1

R4# show ip pim rp mapping
PIM Group-to-RP Mappings

Group(s) 225.225.0.1/32
   RP 120.100.1.1 (?), v2v1
      Info source: 120.100.34.3 (?), elected via Auto-RP
      Uptime: 00:00:00, expires: 00:02:52

Group(s) 225.225.0.2/32
   RP 120.100.1.1 (?), v2v1
      Info source: 120.100.34.3 (?), elected via Auto-RP
      Uptime: 00:00:00, expires: 00:02:51

Group(s) 225.225.0.3/32
   RP 120.100.2.1 (?), v2v1
      Info source: 120.100.34.3 (?), elected via Auto-RP
      Uptime: 00:00:47, expires: 00:02:12

Group(s) 225.225.0.4/32
   RP 120.100.2.1 (?), v2v1
      Info source: 120.100.34.3 (?), elected via Auto-RP
      Uptime: 00:00:47, expires: 00:02:09

Configure R1 to monitor traffic forwarded through itself for traffic destined to the multicast group of 225.225.0.1. If no packet for this group is received within a single 10-second interval, ensure that a Simple Network Management Protocol (SNMP) trap is sent to an SNMP management station on 120.100.100.100 using a community string of public. (2 points)
The IP multicast heartbeat feature facilitates the monitoring of the delivery of IP multicast packets and failure notification based on configurable parameters. If you configure R1 to enable the heartbeat monitoring for the group 225.255.0.1 with the subparameters of 1 and 10, the router monitors a packet lost within 1 interval of 10 seconds and sends an SNMP trap to the SNMP host 120.100.100.100, which is required to be configured within the basic SNMP trap configuration. Example 2-38 details the required multicast heartbeat configuration and verification of the SNMP trap by issue of a ping to 225.225.0.1 from R3. Even though R1 does not have a valid IGMP join group for this group, traffic is still directed to it and the heartbeat process is activated. If you have configured this correctly, as shown in Example 2-38, you have scored 2 points.

**Example 2-38  R1 Multicast Heartbeat Configuration**

```bash
R1(config)# snmp-server host 120.100.100.100 traps public
R1(config)# snmp-server enable traps ipmulticast
R1(config)# ip multicast heartbeat 225.225.0.1 1 1 10
```

```
R1# debug snmp packets

R3# ping 225.225.0.1

R1#SNMP: Queuing packet to 120.100.100.100
SNMP: V1 Trap, ent ciscoExperiment.2.3.1, addr 120.100.100.1, gentrap 8, spectrap 1
    ciscoIpMRouteHeartBeatEntry.2.225.225.0.1 = 120.100.123.3
    ciscoIpMRouteHeartBeatEntry.3.225.225.0.1 = 10
    ciscoIpMRouteHeartBeatEntry.4.225.225.0.1 = 1
    ciscoIpMRouteHeartBeatEntry.5.225.225.0.1 = 0
```
Section 7: Security (7 Points)

- Allow router R6 to passively watch the SYN connections that flow only to VLAN63 for servers that might reside on this subnet. To prevent a potential denial of service (DoS) attack from a flood of SYN requests, configure the router to randomly drop SYN packets from any source to this VLAN that have not been correctly established within 20 seconds. (3 points)

The question requires that the TCP intercept feature be configured on R6. This protects TCP servers from TCP SYN-flooding attacks in the form of a wave of half-opened connections overwhelming the server’s CPU, resulting effectively in a DoS attack. The default behavior of the feature is to intercept the SYN connections to a server and effectively proxy the connection until it has been correctly established. Because you are requested to passively monitor the connection, you are required to configure the feature into watch mode by use of the global `ip tcp intercept mode watch` command. You are also asked to ensure that the feature is enabled only on VLAN63 from any source, so an access list is required to which the intercept feature restricts its monitoring.

The default behavior of the feature is to drop SYN connections based on the oldest first, but the question dictated that random connections must be dropped. This is achieved with the global command `ip tcp intercept drop-mode random`. To ensure that the 20-second limit is met as opposed to the default 30 seconds, you must adjust the timers with the global command `ip tcp intercept watch-timeout 20`. If you have configured this correctly, as shown in Example 2-39, you have scored 3 points. Use the `show tcp intercept connections` command to verify your configuration.

Example 2-39  R6 TCP Intercept Configuration

```
R6(config)# ip tcp intercept list 100
R6(config)# access-list 100 permit tcp any 120.100.63.0 0.0.0.255
R6(config)# ip tcp intercept mode watch
R6(config)# ip tcp intercept drop-mode random
R6(config)# ip tcp intercept watch-timeout 20
```
- Configure an access control list (ACL) on R1 to allow TCP sessions generated on this router and through its Ethernet interface to block TCP sessions from entering on its Frame Relay interface that were not initiated on it or through it originally. Do not use the established feature within standard ACLs to achieve this, and apply ACLs only on the Frame Relay interface. The ACL should time out after 100 seconds of locally initiated TCP inactivity, and it should also allow Internet Control Message Protocol (ICMP) traffic inbound for testing purposes. (4 points)

The question requires that a reflexive ACL be configured on R1. This allows TCP traffic for sessions originating from within the network, but denies TCP traffic for sessions originating from outside the network. The reflexive ACL contains only temporary entries that are automatically created when a new TCP session is initiated. The entries are simply removed 300 seconds after the session ends by default. However, the question requires that this be modified to 100 seconds. To facilitate the reflexive ACL, you must configure a standard ACL inbound on the Frame Relay interface that permits the required traffic inbound to R1 and only returns traffic matching the reflexive ACL. Required traffic is, of course, EIGRP, PIM, IPv6 tunneling, and, as directed, ICMP for testing.

It’s a cruel question because if you forget to permit any of the required traffic inbound, you lose points from a previous section that you might have otherwise achieved full marks in. If you don’t know what protocol IPv6 uses, you can simply use the log option on your inbound ACL on a final deny statement. This shows you that the tunneling from R3 inbound to R1 uses IP protocol 41, which must be included in your inbound ACL.

Example 2-40 shows the required configuration and verification of the reflexive ACL. Because traffic is evaluated by the ACL only as it passes through the router, switch 1 has been configured to belong to VLAN100 to Telnet through R1 to R3 in the example. After it is initiated by switch 1, the Telnet session passes through the ACL FILTER-OUT on R1 and creates an entry in the reflexive ACL DYNAMIC-TCP. You can see real-time details by issuing the show access-lists command on R1. The reflexive ACL permits return traffic to the Telnet session inbound on the Frame Relay interface for the configured inactivity interval of 100 seconds. If you have configured this correctly, as shown in Example 2-40, you have scored 4 points.
Example 2-40  R1 Reflexive ACL Configuration and Verification

R1(config-if)# ip access-list extended FILTER-IN
R1(config-ext-nacl)# permit icmp any any
R1(config-ext-nacl)# permit eigrp any any
R1(config-ext-nacl)# permit pim any any
R1(config-ext-nacl)# permit tcp host 120.100.3.1 host 120.100.1.1 eq bgp
R1(config-ext-nacl)# permit 41 host 120.100.123.3 host 120.100.123.1
R1(config-ext-nacl)# evaluate DYNAMIC-TCP
R1(config-ext-nacl)# ip access-list extended FILTER-OUT
R1(config-ext-nacl)# permit tcp any any reflect DYNAMIC-TCP
R1(config-ext-nacl)# exit
R1(config)# ip reflexive-list timeout 100
R1(config)# interface Serial0/0/0
R1(config-if)# ip access-group FILTER-IN in
R1(config-if)# ip access-group FILTER-OUT out

SW1(config)# interface vlan 100
SW1(config-if)# ip add 120.100.100.100 255.255.255.0
SW1(config-if)# exit
SW1(config)# ip route 120.100.3.1 255.255.255.255 120.100.100.1
SW1(config)# exit
SW1# trace 120.100.3.1

Type escape sequence to abort.
Tracing the route to 120.100.3.1

1 120.100.100.1 0 msec 4 msec 0 msec
2 120.100.100.1 !A * !A
Example 2-40  R1 Reflexive ACL Configuration and Verification  

SW1# telnet 120.100.3.1
Trying 120.100.3.1 ... Open

User Access Verification

Password:
R3> enable
Password:
R3#

R1# show access-lists
Standard IP access list 1
   10 permit 120.100.1.0 (3 matches)
   20 permit 120.100.100.0 (3 matches)
Standard IP access list GROUPS
   10 permit 225.225.0.1
   20 permit 225.225.0.2
   30 permit 225.225.0.3
   40 permit 225.225.0.4
Reflexive IP access list DYNAMIC-TCP
   permit tcp host 120.100.3.1 eq telnet host 120.100.100.100 eq 11034 (34 matches) (time left 90)
Extended IP access list FILTER-IN
   5 permit icmp any any (150 matches)
   10 permit eigrp any any (1710 matches)
   20 permit pim any any (92 matches)
NOTE

The reflexive ACL is valid only for traffic flowing through the router. As such, you might experience connectivity issues if you initiate a Telnet session from R1 without manipulating the Telnet source option. This behavior has no bearing on points scored and should be considered a byproduct of the solution. If you face a similar question in the real exam and Telnet connectivity is required from the router you are configuring, you are specifically instructed to ensure the correct operation of Telnet on that router.

Example 2-40   R1 Reflexive ACL Configuration and Verification   continued

    25 permit tcp host 120.100.3.1 host 120.100.1.1 eq bgp (126 matches)
    30 evaluate DYNAMIC-TCP

Extended IP access list FILTER-OUT

    10 permit tcp any any reflect DYNAMIC-TCP (18 matches)

Lab Wrap-Up

So, how did it go? Did you run out of time? Did you manage to finish, but miss what was actually required? If you scored over 80, well done. If you accomplished this within the time frame, go book your lab!

Did you manage to configure items such EIGRP third-party next hop and the continue statement within your BGP prepending? Items like these might seem inconsequential, but they can make or break your lab.
Summary

Are You Ready?
This became a well-known Cisco slogan that identified the Internet revolution. By the end of this practice exam you should have a good idea if you are ready. Did you feel confident working through the questions, or was it a complete shock to the system? Are you more used to being spoon-fed solitary scenarios than actually having to analyze questions and piece together parts of a complex network jigsaw?

Life is full of challenges. During your education and career, the CCIE Certification is as tough as it gets. The exam is designed to test your technical skills, your understanding and analysis of complex topologies, and your capacity to build a network with IP routing protocols and features. Problems can occur during the exam that you need to troubleshoot with only 8 hours to achieve a minimum score of 80 percent to pass.

Further Reading
The following Cisco Press titles are on topics appearing on the CCIE exam blueprint. These books are not required study resources, but they can be used to build knowledge in certain areas.

CCIE Practical Studies, Volume I (Solie, ISBN# 1587200023)
CCIE Practical Studies, Volume II (CCIE Self-Study) (Solie, Lynch, ISBN# 1587050722)
CCIE Routing and Switching Exam Quick Reference Sheets: Exam 350-001 v3.0 (Sequeira, ISBN #1587053373)
CCIE Routing and Switching Flash Cards (Sequeira and Wallace, ISBN# 1587201291)
CCIE Routing and Switching Practice Labs (Duggan, Gorito, ISBN# 1587051478)
Cisco BGP-4 Command and Configuration Handbook (Parkhurst, ISBN# 158705017X)
Cisco Catalyst QoS: Quality of Service in Campus Networks (Flannagan, Froom, Turek, ISBN# 1587051206)
Cisco Frame Relay Solutions Guide (Chin, ISBN# 1587051168)
Cisco LAN Switching (Clark, Hamilton, ISBN# 1578700949)
Cisco OSPF Command and Configuration Handbook (Parkhurst, ISBN# 1587050714)
Developing IP Multicast Networks, Volume I (Williamson, ISBN# 1578700776)
Implementing Cisco IPv6 Networks (IPv6) (Desmeules, ISBN# 1587050862)
Inside Cisco IOS Software Architecture (Bollapragada, Murphy, White, ISBN# 1578701813)
Internet Routing Architectures, Second Edition (Halabi, ISBN# 15787050862)
MPLS and VPN Architectures (Pepelnjak, Guichard, ISBN# 1587050021)
MPLS and VPN Architectures, Volume II (Pepelnjak, Guichard, Apcear, ISBN# 1587051125)
Routing TCP/IP, Volume II (CCIE Professional Development) (Doyle, DeHaven Carroll, ISBN# 1578700892)
Troubleshooting Remote Access Networks (CCIE Professional Development Series) (Nedeltchev, ISBN# 1587050765)
Help and Advice

- Look at www.cisco.com/go/ccie for the latest information regarding the CCIE Certification, which includes suggested training and reading.
- Keep your schedule flexible during your rack time. Include time for breaks and relaxation. Often 5 minutes away from the keyboard can help you consider possible solutions. Most importantly, do not forget the people you care for and make time for them also.
- Build your study plan based on a balance between theory and practice. You need to understand the concepts through the theory and then consolidate this knowledge during your rack time.
- Begin with simple topics in isolation, and then work up to complex lab scenarios. Spend as much time repeating your configurations as possible to improve your speed and ability to perform basic configurations with your eyes shut. This saves you time for areas where you need it during the exam.
- Explore the Cisco CD documentation or the URL www.cisco.com/univercd/home/home.htm. This is your research lifeline during the exam, a place where you can find information, concepts, and samples regarding all technologies involved in the exam.
- Start to plan for your exam at least 6 months before the lab date.
- If you find this practice lab has highlighted weak areas, do not be afraid to postpone your lab date.

How Can I Schedule My CCIE Lab Exam?

Go to www.cisco.com/go/ccie, and you can find all the information on how to schedule your exam including locations, start times, and more. You must have a CCO user ID and your CCIE written exam date and score to be able to view your profile and schedule your exam.
The Day Before the Exam

If you are traveling to take your exam, try to arrive the day before to familiarize yourself with the area. Take a tour to the lab location so that you won’t be late on the day. The last thing you need to do is to arrive flustered. The day before is a day to be relaxed and not to attempt any last-minute studying. Have a light dinner and try to have a good night’s sleep. Most importantly, save the beer until after the exam. Pass or fail, you will feel like one or two for sure. The CCIE exam might be the reason why Stella Artois is so popular in Brussels!

The Day of the Exam

On the day of the exam, plan to arrive at least 15 minutes before the exam begins for registration. The proctor walks you to the lab and gives you a briefing before the exam starts, telling you about the lab environment, on which rack or station you are going to work, and about the general guidelines for the day.

The proctor cannot discuss solutions or possible solutions for a given question with you. The proctor can help you understand the wording or meaning of the questions; can make sure that the backbone routers and Frame Relay switches are working properly; and can make sure that the hardware and software on your rack are working perfectly so that your exam runs smoothly. Ask the proctor for any assistance or verification; the worst the proctor can say is “Sorry, everything looks okay from my side. Please check your configuration.” Read the entire exam before you start so that you have an idea of the bigger picture, ensuring you fully understand each question and its requirements. Begin by performing easier tasks and leave the most difficult for later. Take some small breaks during the morning and the afternoon to refresh yourself and to relieve the stress.
Pass or Fail, What Next?

If you pass, you certainly have something to celebrate. You have just joined a very elite club, one that no doubt will enhance your career. You have achieved the highest level of certification in the networking world, and you should aim to continue your thirst for knowledge that sets you apart from your peers. But first, take a break before starting your next CCIE track!

If you failed, don’t worry and don’t take it personally. Most people fail the first time around. You have to consider it experience and get back on the keyboard as soon as you can to work out what went wrong. More than likely you will be successful next time and will ultimately become a better engineer for your extra rack time.

I hope this practice exam and these tips are helpful and guide you to take your exam with success.
Appendix A
Lab 1 Router and Switch Configuration Files

Router Configuration Files

Router 1 Initial Configuration

R1# sh run
Building configuration...

Current configuration : 1356 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R1
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
Lab 1 Router and Switch Configuration Files

```
memory-size ionem 10
ip cef
|
|
|
no ip domain lookup
|
voice-card 0
no dspfarm
```
Lab 1 Router and Switch Configuration Files

```
!
!
interface Loopback0
  ip address 120.100.1.1 255.255.255.0
!
interface GigabitEthernet0/0
  no ip address
  shutdown
  duplex auto
  speed auto
  media-type rj45
  negotiation auto
!
interface GigabitEthernet0/1
  ip address 150.100.1.1 255.255.255.0
  ip address 120.100.100.1 255.255.255.0 secondary
  duplex auto
  speed auto
  media-type rj45
  negotiation auto
!
interface Serial0/0/0
  ip address 120.100.123.1 255.255.255.0
  encapsulation frame-relay
  ip ospf network point-to-point
  frame-relay map ip 120.100.123.3 103 broadcast
  no frame-relay inverse-arp

```

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interface Serial0/0/1
   no ip address
   shutdown
 |
 |
 ip http server
 no ip http secure-server
 |
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 control-plane
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password cisco
logging synchronous
login
stopbits 1
line aux 0
stopbits 1
line vty 0 4
   exec-timeout 0 0
   password cisco
   logging synchronous
   login
   transport input telnet
!
scheduler allocate 20000 1000
!
webvpn context Default_context
   ssl authenticate verify all
!
no inservice
!
end

**Router 1 Final Configuration**

R1# sh run
Building configuration...

Current configuration : 3666 bytes

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Lab 1 Router and Switch Configuration Files

! Last configuration change at 21:22:46 UTC Tue Feb 27 2007
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R1
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionem 10
ip cef
!
!
!
!
no ip domain lookup
ip multicast-routing
!
ipv6 unicast-routing
Lab 1 Router and Switch Configuration Files

```plaintext
voice-card 0
  no dsf

class-map match-all VOIP
  match ip dscp ef
class-map match-all BULK-DATA
  match ip dscp af1
class-map match-all NET-WAN
  match ip dscp cs2
class-map match-all VIDEO
  match ip dscp af41
class-map match-all ROUTING
  match ip dscp cs6
```
Lab 1 Router and Switch Configuration Files

```plaintext
class-map match-all SCAVENGER
  match ip dscp cs1
class-map match-all TRANS-DATA
  match ip dscp af21
class-map match-all MISSION-CRIT
  match ip dscp af31
class-map match-all CALL-SIG
  match ip dscp cs3
!
!
policy-map QOS
  class VOIP
    bandwidth percent 16
  class VIDEO
    bandwidth percent 16
  class BULK-DATA
    bandwidth percent 3
    random-detect
  class TRANS-DATA
    bandwidth percent 14
  class NET-MAN
    bandwidth percent 3
  class ROUTING
    bandwidth percent 3
  class SCAVENGER
    bandwidth percent 1
  class MISSION-CRIT
    bandwidth percent 16
    random-detect
```
Lab 1 Router and Switch Configuration Files

class CALL-SIG
  bandwidth percent 3

class class-default
  bandwidth percent 25

interface Tunnel1
  no ip address
  ipv6 address 2007:C15:C0:13::1/64
  ipv6 rip CCIE enable
  tunnel source Serial0/0/0
  tunnel destination 120.100.123.2
  tunnel mode ipv6ip

interface Loopback0
  ip address 120.100.1.1 255.255.255.0
  ip ospf network point-to-point
  ip ospf 1 area 0

interface Loopback1
  ip address 126.1.1.1 255.255.255.0

interface GigabitEthernet0/0
  no ip address
  shutdown
duplex auto
speed auto
media-type rj45
negotiation auto
!
interface GigabitEthernet0/1
  ip address 120.100.100.1 255.255.255.0 secondary
  ip address 150.100.1.1 255.255.255.0
  ip ospf 1 area 100 secondaries none
duplex auto
speed auto
media-type rj45
negotiation auto
ipv6 address 2007:C15:C0:10:1/64
ipv6 rip CCIE enable
!
interface Serial0/0/0
  ip address 120.100.123.1 255.255.255.0
  ip pim sparse-node
  encapsulation frame-relay
  ip ospf network point-to-point
  ip ospf 1 area 0
  ntp multicast client
  ipv6 address 2007:C15:C0:11::1/64
  ipv6 rip CCIE enable
  frame-relay map ip 120.100.123.2 103 broadcast
  frame-relay map ip 120.100.123.3 103 broadcast
  frame-relay map ipv6 2007:C15:C0:11::2 103 broadcast
  frame-relay map ipv6 2007:C15:C0:11::3 103 broadcast
  frame-relay map ipv6 FE80::213:7FFF:FE84:BEE0 103 broadcast
frame-relay map ipv6 FE80::214:6AFF:FEFC:7300 103 broadcast
no frame-relay inverse-arp
max-reserved-bandwidth 100
service-policy output QOS
!
interface Serial0/0/1
no ip address
shutdown
!
router ospf 1
log-adjacency-changes
!
router bgp 10
no synchronization
bgp log-neighbor-changes
network 126.1.1.0 mask 255.255.255.0
eighbor 120.100.3.1 remote-as 10
neighbor 120.100.3.1 update-source Loopback0
no auto-summary
!
ip route 192.0.2.1 255.255.255.255 Null0
!
!
ip http server
no ip http secure-server
!
!
ipv6 router rip CCIE
!
control-plane

line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  transport input telnet
  scheduler allocate 20000 1000
Lab 1 Router and Switch Configuration Files

ntp clock-period 17179866
!
webvpn context Default_context
  ssl authenticate verify all
  !
  no inbservice
  !
end

R1# sh ver
Cisco IOS Software, 3800 Software (C3825-ADVENTERPRISEK9-M), Version 12.4(6)T,
  RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Thu 23-Feb-06 01:02 by ccai

ROM: System Bootstrap, Version 12.3(11r)T2, RELEASE SOFTWARE (fc1)

R1 uptime is 2 hours, 14 minutes
System returned to ROM by reload at 19:15:21 UTC Tue Feb 27 2007
System restarted at 19:11:50 UTC Tue Feb 27 2007
System image file is "flash:c3825-adventerprisek9-mz.124-6.T.bin"

This product contains cryptographic features and is subject to UniteB
States and local country laws governing import, export, transfer anB
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you

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agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:

If you require further assistance please contact us by sending email to
export@cisco.com.

Cisco 3825 (revision 1.0) with 472064K/52224K bytes of memory.
Processor board ID FHK0037F0VU
2 Gigabit Ethernet interfaces
2 Serial(sync/async) interfaces
2 Virtual Private Network (VPN) Modules
DRAM configuration is 64 bits wide with parity enabled.
479K bytes of NVRAM.
62720K bytes of ATA System CompactFlash (Read/Write)

Configuration register is 0x2102

R1# sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
M1 - OSPF NSSA external type 1, M2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
* - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

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Lab 1 Router and Switch Configuration Files

126.0.0.0/24 is subnetted, 1 subnets
C  126.1.1.0 is directly connected, Loopback0
130.1.0.0/24 is subnetted, 1 subnets
B  130.1.1.0 [200/0] via 120.100.2.1, 00:18:22
130.100.0.0/24 is subnetted, 1 subnets
B  130.100.200.0 [200/0] via 120.100.2.1, 00:18:22
192.0.2.0/32 is subnetted, 1 subnets
S  192.0.2.1 is directly connected, Null0
150.100.0.0/16 is variably subnetted, 4 subnets, 2 masks
B  150.100.2.100/32 [200/0] via 192.0.2.1, 00:16:36
0 IA 150.100.2.0/24 [110/129] via 120.100.123.3, 01:21:58, Serial0/0/0
0 E2 150.100.3.0/24 [110/5000] via 120.100.123.3, 01:05:07, Serial0/0/0
C  150.100.1.0/24 is directly connected, GigabitEthernet0/1
120.0.0.0/8 is variably subnetted, 12 subnets, 2 masks
0 IA 120.100.25.0/24 [110/129] via 120.100.123.3, 01:06:51, Serial0/0/0
0 IA 120.100.4.0/24 [110/66] via 120.100.123.3, 01:21:59, Serial0/0/0
0 IA 120.100.5.0/24 [110/193] via 120.100.123.3, 01:06:51, Serial0/0/0
0 E2 120.100.6.0/24 [110/5000] via 120.100.123.3, 01:05:08, Serial0/0/0
C  120.100.1.0/24 is directly connected, Loopback0
0 120.100.2.0/24 [110/129] via 120.100.123.3, 01:21:59, Serial0/0/0
0 120.100.3.0/24 [110/66] via 120.100.123.3, 01:21:59, Serial0/0/0
0 IA 120.100.45.0/24 [110/66] via 120.100.123.3, 01:05:08, Serial0/0/0
0 IA 120.100.34.0/24 [110/66] via 120.100.123.3, 01:21:59, Serial0/0/0
0 120.100.123.3/32 [110/64] via 120.100.123.3, 01:21:59, Serial0/0/0
C  120.100.123.0/24 is directly connected, Serial0/0/0
C  120.100.100.0/24 is directly connected, GigabitEthernet0/1

R1# sh ip route ospf
150.100.0.0/16 is variably subnetted, 4 subnets, 2 masks
0 IA  150.100.2.0/24 [110/129] via 120.100.123.3, 01:22:08, Serial0/0/0
Lab 1 Router and Switch Configuration Files

0 E2 150.100.3.0/24 [110/5000] via 120.100.123.3, 01:05:18, Serial0/0/0
120.0.0.0/8 is variably subnetted, 12 subnets, 2 masks
0 IA 120.100.25.0/24 [110/192] via 120.100.123.3, 01:07:01, Serial0/0/0
0 IA 120.100.4.0/24 [110/66] via 120.100.123.3, 01:22:08, Serial0/0/0
0 IA 120.100.5.0/24 [110/193] via 120.100.123.3, 01:07:01, Serial0/0/0
0 E2 120.100.6.0/24 [110/5000] via 120.100.123.3, 01:05:18, Serial0/0/0
0 120.100.2.0/24 [110/129] via 120.100.123.3, 01:22:08, Serial0/0/0
0 120.100.3.0/24 [110/65] via 120.100.123.3, 01:22:08, Serial0/0/0
0 IA 120.100.45.0/24 [110/66] via 120.100.123.3, 01:05:18, Serial0/0/0
0 IA 120.100.34.0/24 [110/65] via 120.100.123.3, 01:22:08, Serial0/0/0
0 120.100.123.3/32 [110/64] via 120.100.123.3, 01:22:08, Serial0/0/0

R1# sh ip bgp
BGP table version is 13, local router ID is 120.100.1.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
               r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*&gt; 126.1.1.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td>32768</td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>*&gt;i130.1.1.0/24</td>
<td>120.100.2.1</td>
<td>100</td>
<td></td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>*&gt;i130.100.200.0/24</td>
<td>120.100.2.1</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>*&gt;i150.100.2.100/32</td>
<td>192.0.2.1</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>?</td>
</tr>
</tbody>
</table>

R1# sh ipv6 route
IPv6 Routing Table - 13 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
U - Per-user Static route
I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
D - EIGRP, EX - EIGRP external
Lab 1 Router and Switch Configuration Files

R 2007::/16 [120/3]
   via FE80::7864:7B02, Tunnel1
C 2007:C15:C0:10::/64 [0/0]
   via ::, GigabitEthernet0/1
L 2007:C15:C0:10::1/128 [0/0]
   via ::, GigabitEthernet0/1
C 2007:C15:C0:11::/64 [0/0]
   via ::, Serial0/0/0
L 2007:C15:C0:11::1/128 [0/0]
   via ::, Serial0/0/0
R 2007:C15:C0:12::/64 [120/2]
   via FE80::7864:7B02, Tunnel1
C 2007:C15:C0:13::/64 [0/0]
   via ::, Tunnel1
L 2007:C15:C0:13::1/128 [0/0]
   via ::, Tunnel1
R 2007:C15:C0:14::/64 [120/2]
   via FE80::7864:7B02, Tunnel1
R 2007:C15:C0:15::/64 [120/2]
   via FE80::214:6AFF:FEFC:7390, Serial0/0/0
R 2007:C15:C0:17::/64 [120/3]
   via FE80::214:6AFF:FEFC:7390, Serial0/0/0
L FE80::/10 [0/0]
   via ::, Null0
L FF00::/8 [0/0]
   via ::, Null0
R1#
Router 2 Initial Configuration

R2# sh run
Building configuration...

Current configuration : 1470 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R2
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionem 15
ip cef
!
!
no ip domain lookup

interface Loopback0
  ip address 120.100.2.1 255.255.255.0

interface FastEthernet0/0
  no ip address
shutdown
duplex auto
speed auto
!
interface Serial0/0
ip address 120.100.123.2 255.255.255.0
encapsulation frame-relay
ip ospf network point-to-point
frame-relay map ip 120.100.123.3 203 broadcast
no frame-relay inverse-arp
!
interface FastEthernet0/1
ip address 150.100.2.1 255.255.255.0
duplex auto
speed auto
!
interface Serial0/1
ip address 120.100.25.2 255.255.255.0
encapsulation frame-relay
ip ospf network point-to-point
frame-relay map ip 120.100.25.5 215 broadcast
no frame-relay inverse-arp
!
!
!
ip http server
no ip http secure-server
!
!
Lab 1 Router and Switch Configuration Files

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Lab 1 Router and Switch Configuration Files

webvpn context Default_context
  ssl authenticate verify all
!
  no in_service
!
!
end

Router 2 Final Configuration

R2# sh run
Building configuration...

Current configuration : 3381 bytes
!
! Last configuration change at 21:22:46 UTC Tue Feb 27 2007
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R2
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionem 15
ip cef
!
!
!
no ip domain lookup
ip multicast-routing
!
ipv6 unicast-routing
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Lab 1 Router and Switch Configuration Files

interface Tunnel1
   no ip address
   ipv6 address 2007:0C15:00:13::2/64
   ipv6 rip CCIE enable
   tunnel source Serial0/0
   tunnel destination 120.100.123.1
   tunnel mode ipv6ip

interface Loopback0
   ip address 120.100.2.1 255.255.255.0
   ip ospf network point-to-point
   ip ospf 1 area 0

interface Loopback1
   ip address 130.1.1.1 255.255.255.0

interface Loopback2
   ip address 130.100.200.1 255.255.255.0

interface FastEthernet0/0
   no ip address
   shutdown
duplex auto
speed auto
!
interface Serial0/0
  ip address 120.100.123.2 255.255.255.0
  ip pim sparse-mode
  encapsulation frame-relay
  ip ospf network point-to-point
  ip ospf 1 area 0
  ntp multicast client
  ipv6 address 2007:C15:00:11::2/64
  ipv6 rip CCIE enable
  frame-relay map ip 120.100.123.1 203 broadcast
  frame-relay map ipv6 2007:C15:00:11::1 203 broadcast
  frame-relay map ip 120.100.123.3 203 broadcast
  frame-relay map ipv6 2007:C15:00:11::3 203 broadcast
  frame-relay map ipv6 2007:C15:00:10::12 203 broadcast
  frame-relay map ipv6 FE80::213:C3FF:FE7B:E3C1 203 broadcast
  frame-relay map ipv6 FE80::214:6AFF:FEFC:7390 203 broadcast
  no frame-relay inverse-arp
!
interface FastEthernet0/1
  ip address 150.100.2.1 255.255.255.0
  ip ospf 1 area 200
  duplex auto
  speed auto
  ipv6 address 2007:C15:00:12::2/64
  ipv6 rip CCIE enable
!
interface Serial0/1
  ip address 120.100.25.2 255.255.255.0
  encapsulation frame-relay
  ip ospf network point-to-point
  ip ospf 1 area 5
  ipv6 address 2007::C15:C0:14::2/64
  ipv6 rip CCIE enable
  frame-relay map ipv6 FE80::214:6AFF:FEFC:F130 215 broadcast
  frame-relay map ipv6 2007::C15:C0:14::5 215 broadcast
  frame-relay map ip 120.100.25.5 215 broadcast
  no frame-relay inverse-arp

router ospf 1
  log-adjacency-changes

router bgp 10
  no synchronization
  bgp log-neighbor-changes
  network 130.1.1.0 mask 255.255.255.0
  network 130.100.200.0 mask 255.255.255.0
  redistribute static route-map BLACKHOLE
  neighbor 120.100.3.1 remote-as 10
  neighbor 120.100.3.1 send-community
  neighbor 120.100.3.1 route-map NO-EXPORT out
  neighbor 120.100.5.1 remote-as 300
  neighbor 120.100.5.1 ebgp-multihop 2
  neighbor 120.100.5.1 update-source Loopback0
  no auto-summary

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ip route 150.100.2.100 255.255.255.255 Null0 tag 10
ip route 192.0.2.1 255.255.255.255 Null0

ip http server
no ip http secure-server

access-list 5 permit 130.100.200.0

ipv6 router rip CCIE

route-map NO-EXPORT permit 10
  match ip address 5
  set community no-export

route-map NO-EXPORT permit 20

route-map BLACKHOLE permit 10
  match tag 10
  set ip next-hop 192.0.2.1
  set community no-export

control-plane
Lab 1 Router and Switch Configuration Files

```
!
!
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!
!
line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  stopbits 1
line aux 0
line vty 0 4
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  transport input telnet
!
ntp clock-period 17179877
!
webvpn context Default_context
  ssl authenticate verify all
!
  no inservice
!
end
```
R2# sh version
Cisco IOS Software, 3700 Software (C3725-ADVENTERPRISEK9-M), Version 12.4(6)T, RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Thu 23-Feb-06 00:26 by ccai

ROM: System Bootstrap, Version 12.2(8r)T2, RELEASE SOFTWARE (fc1)

R2 uptime is 2 hours, 16 minutes
System returned to ROM by relaB
System restarted at 19:11:44 UTC Tue Feb 27 2007
System image file is 'flash:c3725-adventerprisek9-mz.124-6.T.bin'

This product contains cryptographic features and is subject to UniteB States and local country laws governing import, export, transfer and use. Delivery of Cisco cryptographic products does not imply third-party authority to import, export, distribute or use encryption. Importers, exporters, distributors and users are responsible for compliance with U.S. and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at: http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to export@cisco.com.
Cisco 3725 (R7000) processor (revision 0.1) with 223232K/38912K bytes of memory.
Processor board ID JW4016L02F
R7000 CPU at 240MHz, Implementation 39, Rev 3.3, 256KB L2 Cache
2 FastEthernet interfaces
2 Serial(sync/async) interfaces
DRAM configuration is 64 bits wide with parity disabled.
55K bytes of NVRAM.
125184K bytes of ATA System CompactFlash (Read/Write)

Configuration register is 0x2102

R2# sh ip route
Codes: C - connected, S - static, R - RIP, W - mobile, B - BGP
     D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
     N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
     E1 - OSPF external type 1, E2 - OSPF external type 2
     i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
     ia - IS-IS inter area, * - candidate default, U - per-user static route
     o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

    126.0.0.0/24 is subnets, 1 subnets
B    126.1.1.0 [200/0] via 120.100.1.1, 00:20:47
    130.1.0.0/24 is subnets, 1 subnets
C    130.1.1.0 is directly connected, Loopback1
    130.100.0.0/24 is subnets, 1 subnets
C    130.100.200.0 is directly connected, Loopback2
    192.0.2.0/32 is subnets, 1 subnets
Lab 1 Router and Switch Configuration Files

S  192.0.2.1 is directly connected, Null0
    150.100.0.0/16 is variably subnetted, 4 subnets, 2 masks
S  150.100.2.100/32 is directly connected, Null0
C  150.100.2.0/24 is directly connected, FastEthernet0/1
O E2  150.100.3.0/24 [110/5000] via 120.100.25.5, 01:07:34, Serial0/1
O IA  150.100.1.0/24 [110/129] via 120.100.123.3, 01:07:34, Serial0/0
    120.0.0.0/8 is variably subnetted, 11 subnets, 2 masks
C  120.100.25.0/24 is directly connected, Serial0/1
O IA  120.100.4.0/24 [110/68] via 120.100.123.3, 01:07:34, Serial0/0
O  120.100.5.0/24 [110/65] via 120.100.25.5, 01:07:34, Serial0/1
0 E2  120.100.6.0/24 [110/5000] via 120.100.123.3, 01:07:34, Serial0/0
O  120.100.1.0/24 [110/129] via 120.100.123.3, 01:23:33, Serial0/0
C  120.100.2.0/24 is directly connected, Loopback0
O  120.100.3.0/24 [110/65] via 120.100.123.3, 01:23:33, Serial0/0
O  120.100.45.0/24 [110/65] via 120.100.25.5, 01:07:34, Serial0/1
0 IA  120.100.34.0/24 [110/68] via 120.100.123.3, 01:07:34, Serial0/0
O  120.100.123.3/32 [110/64] via 120.100.123.3, 01:23:33, Serial0/0
C  120.100.123.0/24 is directly connected, Serial0/0

R2# show ip route ospf
    150.100.0.0/16 is variably subnetted, 4 subnets, 2 masks
O E2  150.100.3.0/24 [110/5000] via 120.100.25.5, 01:07:49, Serial0/1
O IA  150.100.1.0/24 [110/129] via 120.100.123.3, 01:07:49, Serial0/0
    120.0.0.0/8 is variably subnetted, 11 subnets, 2 masks
0 IA  120.100.4.0/24 [110/68] via 120.100.123.3, 01:07:49, Serial0/0
O  120.100.5.0/24 [110/65] via 120.100.25.5, 01:07:49, Serial0/1
0 E2  120.100.6.0/24 [110/5000] via 120.100.123.3, 01:07:49, Serial0/0
0  120.100.1.0/24 [110/129] via 120.100.123.3, 01:23:48, Serial0/0
O  120.100.3.0/24 [110/65] via 120.100.123.3, 01:23:48, Serial0/0
0  120.100.45.0/24 [110/65] via 120.100.25.5, 01:07:49, Serial0/1
0 IA  120.100.34.0/24 [110/68] via 120.100.123.3, 01:07:49, Serial0/0

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Lab 1 Router and Switch Configuration Files

0 120.100.123.3/32 [110/64] via 120.100.123.3, 01:23:48, Serial0/0

R2# sh ip bgp
BGP table version is 5, local router ID is 130.100.200.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*10.1.1.0/24</td>
<td>120.100.1.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>*10.1.1.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td>32768</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>*10.1.2.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td>32768</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>*10.1.2.0/24</td>
<td>192.0.2.1</td>
<td>0</td>
<td>32768</td>
<td>?</td>
<td></td>
</tr>
</tbody>
</table>

R2# sh ipv6 route
IPv6 Routing Table - 14 entries
 Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
U - Per-user Static route
I1 - ISIS L1, I2 - ISIS L2, IA - ISIS intra-area, IS - ISIS summary
O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
D - EIGRP, EX - EIGRP external

R 2007::/16 [120/2]
via FE80::214:8AFF:FEFC:F130, Serial0/1

R 2007::/16 [120/2]
via FE80::214:8AFF:FEFC:F130, Serial0/1

C 2007::/16 [120/2]
via ::, Serial0/0

L 2007::/16 [120/2]
via ::, Serial0/0

C 2007::/16 [120/2]
via ::, FastEthernet0/1
Lab 1 Router and Switch Configuration Files

L 2007:C15:C0:12::2/128 [0/0]
   via ::, FastEthernet0/1
C 2007:C15:C0:13::/64 [0/0]
   via ::, Tunnel1
L 2007:C15:C0:13::2/128 [0/0]
   via ::, Tunnel1
C 2007:C15:C0:14::/64 [0/0]
   via ::, Serial0/1
L 2007:C15:C0:14::2/128 [0/0]
   via ::, Serial0/1
R 2007:C15:C0:15::/64 [120/2]
   via FE80::214:0AFF:FEFC:7390, Serial0/0
R 2007:C15:C0:17::/64 [120/3]
   via FE80::214:0AFF:FEFC:7390, Serial0/0
L FE80::/10 [0/0]
   via ::, Null0
L FF00::/8 [0/0]
   via ::, Null0
R2#

Router 3 Initial Configuration

R3# sh run
Building configuration...

Current configuration : 1523 bytes
!
version 12.4
service timestamps debug datetime msec
Lab 1 Router and Switch Configuration Files

```
service timestamps log datetime msec
no service password-encryption
!
hostname R3
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionmem 15
ip cef
!
!
!
!
no ip domain lookup
!
voice-card 0
no dspfarm
!
!
!
!

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Lab 1 Router and Switch Configuration Files

interface Loopback0
  ip address 120.100.3.1 255.255.255.0

interface GigabitEthernet0/0
  ip address 120.100.34.3 255.255.255.0
  duplex auto
  speed auto
  media-type rj45
  negotiation auto

interface GigabitEthernet0/1
  no ip address
  shutdown
  duplex auto
Lab 1 Router and Switch Configuration Files

```plaintext
speed auto
media-type rj45
negotiation auto

interface Serial0/0/0
ip address 120.100.123.3 255.255.255.0
encapsulation frame-relay
ip ospf network point-to-multipoint
frame-relay map ip 120.100.123.1 301 broadcast
frame-relay map ip 120.100.123.2 302 broadcast
no frame-relay inverse-arp

interface Serial0/0/1
no ip address
shutdown

ip http server
no ip http secure-server

control-plane
```

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Lab 1 Router and Switch Configuration Files

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!
Router 3 Final Configuration

R3# sh run
Building configuration...

Current configuration : 3092 bytes
!
! Last configuration change at 21:22:46 UTC Tue Feb 27 2007
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R3
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionem 15
ip cef
!
!

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Lab 1 Router and Switch Configuration Files

ip nbar custom Hastings_Beer 2 ascii Hastings_Beer udp range 11664 11666
!
!
no ip domain lookup
ip multicast-routing
!
ipv6 unicast-routing
voice-card 0
no dspfarm
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
class-map match-all VIRUS
   match protocol Hastings_Beer
!
!
policy-map BLOCK-VIRUS
  class VIRUS
    drop

interface Loopback0
  ip address 120.100.3.1 255.255.255.0
  ip ospf network point-to-point
  ip ospf 1 area 0

interface GigabitEthernet0/0
  ip address 120.100.34.3 255.255.255.0
  ip pim sparse-node
  ip ospf 1 area 34
duplex auto
speed auto
media-type rj45
negotiation auto
ntp multicast ttl 2
ipv6 address 2007:C15:0:15::3/64
ipv6 rip CCIE enable
service-policy input BLOCK-VIRUS

interface GigabitEthernet0/1
no ip address
shutdown
duplex auto
speed auto
media-type rj45
negotiation auto
!
interface Serial0/0/0
  ip address 120.100.123.3 255.255.255.0
  ip pim sparse-mode
  encapsulation frame-relay
  ip ospf network point-to-multipoint
  ip ospf hello-interval 10
  ip ospf 1 area 0
  ipv6 address 2007:C15:C0:11::3/64
  ipv6 rip CCIE enable
  frame-relay map ip 120.100.123.1 301 broadcast
  frame-relay map ip 120.100.123.2 302 broadcast
  frame-relay map ipv6 2007:C15:C0:11::1 301 broadcast
  frame-relay map ipv6 2007:C15:C0:11::2 302 broadcast
  no frame-relay inverse-arp
!
interface Serial0/0/1
  no ip address
  shutdown
!
router ospf 1
  log-adjacency-changes
  area 34 virtual-link 120.100.4.1
!
router bgp 10
  no synchronization
  bgp log-neighbor-changes
  neighbor IBGP peer-group
  neighbor IBGP remote-as 10
  neighbor IBGP update-source Loopback0
  neighbor IBGP route-reflector-client
  neighbor 120.100.1.1 peer-group IBGP
  neighbor 120.100.1.1 route-map UPTof28 in
  neighbor 120.100.2.1 peer-group IBGP
  neighbor 120.100.2.1 route-map ABOVE128 in
  neighbor 120.100.4.1 remote-as 200
  neighbor 120.100.4.1 ebgp-multihop 2
  neighbor 120.100.4.1 update-source Loopback0
  no auto-summary
!
ip route 192.0.2.1 255.255.255.255 Null0
!
!
ip http server
no ip http secure-server
ip pim send-rp-announce GigabitEthernet0/0 scope 2 group-list 4
ip pim send-rp-discovery GigabitEthernet0/0 scope 2
!
access-list 1 permit 0.0.0.0 127.255.255.255
access-list 4 permit 224.0.1.1
!
!
ipv6 router rip CCIE
!
!
route-map UPT0128 permit 10
  match ip address 1
|
route-map ABOVE128 permit 10
  match ip address 1
|
route-map ABOVE128 permit 20
|
|
|
control-plane
|
|
|
|
line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  stopbits 1
line aux 0
  stopbits 1
Lab 1 Router and Switch Configuration Files

```
line vty 0 4
    exec-timeout 0 0
    password cisco
    logging synchronous
    login
    transport input telnet
!
scheduler allocate 20000 1000
ntp master
!
webvpn context Default_context
    ssl authenticate verify all
!
    no inservice
!
end
```

R3# sh version
Cisco IOS Software, 3800 Software (C3825-ADVENTERPRISEK9-M), Version 12.4(6)T,
    RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Thu 23-Feb-06 01:02 by ccai

ROM: System Bootstrap, Version 12.3(11r)T2, RELEASE SOFTWARE (fc1)

R3 uptime is 2 hours, 18 minutes
System returned to ROM by reload at 19:09:55 UTC Tue Feb 27 2007
System restarted at 19:11:42 UTC Tue Feb 27 2007
System image file is "flash:c3825-adventerprisek9-mz.124-6.T.bin"

This product contains cryptographic features and is subject to United States and local country laws governing import, export, transfer and use. Delivery of Cisco cryptographic products does not imply third-party authority to import, export, distribute or use encryption. Importers, exporters, distributors and users are responsible for compliance with U.S. and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at: http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to export@cisco.com.

Cisco 3825 (revision 1.0) with 446464K/77824K bytes of memory.
Processor board ID FHK937F030
2 Gigabit Ethernet interfaces
2 Serial(sync/async) interfaces
2 Virtual Private Network (VPN) Modules
DRAM configuration is 64 bits wide with parity enabled.
479K bytes of NVRAM.
62720K bytes of ATA System CompactFlash (Read/Write)

Configuration register is 0x2102
R3# sh ip route

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
L1 - IS-IS level-1, L2 - IS-IS level-2
S - IS-IS summary, L12 - IS-IS level-1/2, IA - IS-IS inter area,
O - ODR, P - periodic downloaded static route

Gateway of last resort is not set

126.0.0.0/24 is subnets, 1 subnets
B   126.1.1.0 [200/0] via 120.100.1.1, 01:09:46
130.1.0.0/24 is subnets, 1 subnets
B   130.1.1.0 [200/0] via 120.100.2.1, 00:22:22
130.100.0.0/24 is subnets, 1 subnets
B   130.100.200.0 [200/0] via 120.100.2.1, 00:22:22
192.0.2.0/32 is subnets, 1 subnets
S   192.0.2.1 is directly connected, Null0
150.100.0.0/16 is variably subnets, 4 subnets, 2 masks
B   150.100.2.100/32 [200/0] via 192.0.2.1, 00:21:20
O IA 150.100.2.0/24 [110/65] via 120.100.123.2, 01:24:33, Serial0/0/0
O E2 150.100.3.0/24
    [110/5000] via 120.100.34.4, 01:00:07, GigabitEthernet0/0
O IA 150.100.1.0/24 [110/65] via 120.100.123.1, 01:24:34, Serial0/0/0
120.0.0.0/24 is subnets, 10 subnets
O IA 120.100.25.0 [110/128] via 120.100.123.2, 01:10:51, Serial0/0/0
O  120.100.4.0 [110/2] via 120.100.34.4, 01:26:59, GigabitEthernet0/0
O IA 120.100.5.0 [110/129] via 120.100.123.2, 01:10:51, Serial0/0/0
O E2 120.100.6.0 [110/5000] via 120.100.34.4, 01:00:08, GigabitEthernet0/0
Lab 1 Router and Switch Configuration Files

```
0 120.100.1.0 [110/65] via 120.100.123.1, 01:24:34, Serial0/0/0
0 120.100.2.0 [110/65] via 120.100.123.2, 01:24:34, Serial0/0/0
C 120.100.3.0 is directly connected, Loopback0
0 IA 120.100.45.0 [110/2] via 120.100.34.4, 01:00:00, GigabitEthernet0/0
C 120.100.34.0 is directly connected, GigabitEthernet0/0
C 120.100.123.0 is directly connected, Serial0/0/0

R3# sh ip route ospf
150.100.0.0/16 is variably subnetted, 4 subnets, 2 masks
0 IA 150.100.2.0/24 [110/65] via 120.100.123.2, 01:24:39, Serial0/0/0
0 E2 150.100.3.0/24
       [110/5000] via 120.100.34.4, 01:00:13, GigabitEthernet0/0
0 IA 150.100.1.0/24 [110/65] via 120.100.123.1, 01:24:39, Serial0/0/0
120.0.0.0/24 is subnetted, 10 subnets
0 IA 120.100.25.0 [110/128] via 120.100.123.2, 01:10:56, Serial0/0/0
0 120.100.4.0 [110/2] via 120.100.34.4, 01:27:04, GigabitEthernet0/0
0 IA 120.100.5.0 [110/129] via 120.100.123.2, 01:10:56, Serial0/0/0
0 E2 120.100.6.0 [110/5000] via 120.100.34.4, 01:00:13, GigabitEthernet0/0
0 120.100.1.0 [110/65] via 120.100.123.1, 01:24:39, Serial0/0/0
0 120.100.2.0 [110/65] via 120.100.123.2, 01:24:39, Serial0/0/0
0 IA 120.100.45.0 [110/2] via 120.100.34.4, 01:00:13, GigabitEthernet0/0

R3# sh ip bgp
BGP table version is 9, local router ID is 120.100.3.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*&gt;i26.1.1.0/24</td>
<td>120.100.1.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>*&gt;i30.1.1.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>*&gt;i30.100.200.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
</tbody>
</table>
```
Lab 1 Router and Switch Configuration Files

R## sh ipv6 route
IPv6 Routing Table - 12 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
        U - Per-user Static route
        I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
        O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
        ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
        D - EIGRP, EX - EIGRP external

R  2007::/16 [120/3]
   via FE80::213:7FF:FE84:BEE0, Serial0/0/0
R  2007:C15:C0:10::/64 [120/2]
   via FE80::213:C3FF:FE7B:E3C0, Serial0/0/0
C  2007:C15:C0:11::/64 [0/0]
   via ::, Serial0/0/0
L  2007:C15:C0:11::3/128 [0/0]
   via ::, Serial0/0/0
R  2007:C15:C0:12::/64 [120/2]
   via FE80::213:7FF:FE84:BEE0, Serial0/0/0
R  2007:C15:C0:13::/64 [120/2]
   via FE80::213:C3FF:FE7B:E3C0, Serial0/0/0
   via FE80::213:7FF:FE84:BEE0, Serial0/0/0
R  2007:C15:C0:14::/64 [120/2]
   via FE80::213:7FF:FE84:BEE0, Serial0/0/0
C  2007:C15:C0:15::/64 [0/0]
   via ::, GigabitEthernet0/0
L  2007:C15:C0:15::3/128 [0/0]
   via ::, GigabitEthernet0/0
R  2007:C15:C0:17::/64 [120/2]
   via FE80::213:C3FF:FE7B:E4A0, GigabitEthernet0/0
Lab 1 Router and Switch Configuration Files

```
R3# FE80::/10 [0/0]
    via ::, Null0
L FF00::/8 [0/0]
    via ::, Null0
R3#
```

Router 4 Initial Configuration

```
R4# sh run
Building configuration...

Current configuration : 1373 bytes

version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption

hostname R4

boot-start-marker
boot-end-marker

no logging console
enable password cisco

no aaa new-model

resource policy

```

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Lab 1 Router and Switch Configuration Files

```
ip cef
 |
 |
 |
 |
|
no ip domain lookup
|
v voice-card 0
 |no dspfarm
 |
```

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Lab 1 Router and Switch Configuration Files

!
!
interface Loopback0
 ip address 120.100.4.1 255.255.255.0
!
interface GigabitEthernet0/0
 ip address 120.100.34.4 255.255.255.0
duplex auto
 speed auto
 media-type rj45
 negotiation auto
!
interface GigabitEthernet0/1
 description Gi0/1 used for comm with R5 and R6
 no ip address
duplex auto
 speed auto
 media-type rj45
 negotiation auto
!
interface Serial0/0/0
 no ip address
 shutdown
!
interface Serial0/0/1
 no ip address
 shutdown
!

Lab 1 Router and Switch Configuration Files

ip http server
no ip http secure-server

control-plane

line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  exec-timeout 0 0
Lab 1 Router and Switch Configuration Files

password cisco
logging synchronous
login
transport input telnet
!
scheduler allocate 20000 1000
!
webvpn context Default_context
ss1 authenticate verify all
!
no inservice
!
!
end

Router 4 Final Configuration

R4# sh run
Building configuration...

Current configuration : 3031 bytes
!
! Last configuration change at 21:22:46 UTC Tue Feb 27 2007
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
Lab 1 Router and Switch Configuration Files

hostname R4
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionsm 10
ip cef
!
!
!
!
!
!
no ip domain lookup
ip multicast-routing
!
ipv6 unicast-routing
voice-card 0
no ds pfarm
!
!
!
!
!
!
!

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interface Tunnel0
  no ip address
  ipv6 address 2001:015:00:17::4/64
  ipv6 rip CCIE enable
  ipv6 rip CCIE metric-offset 4
  tunnel source GigabitEthernet0/1.45
  tunnel destination 120.100.45.5
  tunnel mode ipv6ip

interface Loopback0
  ip address 120.100.4.1 255.255.255.0
  ip ospf network point-to-point
  ip ospf 1 area 34

Lab 1 Router and Switch Configuration Files

interface GigabitEthernet0/0
  ip address 120.100.34.4 255.255.255.0
  ip pim sparse-mode
  ip ospf 1 area 34
  duplex auto
  speed auto
  media-type rj45
  negotiation auto
  ntp multicast client
  ipv6 address 2007:015::015::4/64
  ipv6 rip CCIE enable

interface GigabitEthernet0/1
  description Gi0/1 used for comm with R5 and R6
  no ip address
  duplex auto
  speed auto
  media-type rj45
  negotiation auto

interface GigabitEthernet0/1.45
  encapsulation dot1q 45
  ip address 120.100.45.4 255.255.255.0
  ip ospf network non-broadcast
  ip ospf 1 area 5
  no snmp trap link-status

interface GigabitEthernet0/1.46
  encapsulation dot1q 46
Lab 1 Router and Switch Configuration Files

```
ip address 120.100.46.4 255.255.255.0
no snmp trap link-status
!
interface Serial0/0/0
  no ip address
  shutdown
!
interface Serial0/0/1
  no ip address
  shutdown
!
router eigrp 1
  redistribute ospf 1
  network 120.100.4.1 0.0.0.0
  network 120.100.45.4 0.0.0.0
  network 120.100.46.4 0.0.0.0
  metric maximum-hops 1
  default-metric 10000 100 255 1 1500
  distribute-list route-map CHANGEMETRIC in
  no auto-summary
!
router ospf 1
  log-adjacency-changes
  area 34 virtual-link 120.100.3.1
  redistribute maximum-prefix 5 80
  redistribute eigrp 1 subnets
  neighbor 120.100.45.5
  default-metric 5000
```
Lab 1 Router and Switch Configuration Files

```
router bgp 200
  no synchronization
  bgp log-neighbor-changes
  neighbor 120.100.3.1 remote-as 10
  neighbor 120.100.3.1 ebgp-multihop 2
  neighbor 120.100.3.1 update-source Loopback0
  neighbor 120.100.6.1 remote-as 300
  neighbor 120.100.6.1 ebgp-multihop 2
  neighbor 120.100.6.1 update-source Loopback0
  neighbor 120.100.45.5 remote-as 300
  no auto-summary

ip http server
no ip http secure-server

ipv6 router rip CCIE

route-map CHANSEMERIC permit 10
  match interface GigabitEthernet0/1.45
  set metric 2000 10 255 1 1500

route-map CHANSEMERIC permit 20
  set metric 1000 10 255 1 1500
```

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Lab 1 Router and Switch Configuration Files

! control-plane
!
!
!
!
!
!
!
!
!
!
!
!
!

line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  transport input telnet
!
scheduler allocate 20000 1000
ntp clock-period 17179865
!
webvpn context Default_context
ssl authenticate verify all
!
no inservice
!
!
end

R4# sh version
Cisco IOS Software, 3800 Software (C3825-ADVENTERPRISEK9-M), Version 12.4(6)T,
RELEA SE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Thu 23-Feb-06 01:02 by ccai

ROM: System Bootstrap, Version 12.3(11r)T2, RELEASE SOFTWARE (fc1)

R4 uptime is 2 hours, 19 minutes
System returned to ROM by reload at 19:09:29 UTC Tue Feb 27 2007
System restarted at 19:11:37 UTC Tue Feb 27 2007
System image file is 'flash:c3825-adventureprisek9-mz.124-8.T.bin'

This product contains cryptographic features and is subject to United States and local country laws governing import, export, transfer and use. Delivery of Cisco cryptographic products does not imply third-party authorization to import, export, distribute or use encryption. Importers, exporters, distributors and users are responsible for compliance with U.S. and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return this product immediately.
A summary of U.S. laws governing Cisco cryptographic products may be found at:

If you require further assistance please contact us by sending email to export@cisco.com.

Cisco 3625 (revision 1.0) with 472064K/52224K bytes of memory.
Processor board ID FHK0937F0XH
2 Gigabit Ethernet interfaces
2 Serial(sync/async) interfaces
2 Virtual Private Network (VPN) Modules
DRAM configuration is 64 bits wide with parity enabled.
479K bytes of NVRAM.
62720K bytes of ATA System CompactFlash (Read/Write)

Configuration register is 0x2102

R4# sh ip route
Codes: C - connected, S - static, R - RIP, W - mobile, B - BGP
     D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
     N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
     E1 - OSPF external type 1, E2 - OSPF external type 2
     i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
     * - IS-IS inter area, ? - candidate default, U - per-user static route
     o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

    126.0.0.0/24 is subnetted, 1 subnets
B     126.1.1.0 [20/0] via 120.100.3.1, 01:10:59
    130.1.0.0/24 is subnetted, 1 subnets
Lab 1 Router and Switch Configuration Files

B  130.1.1.0 [20/0] via 120.100.3.1, 00:23:35
   130.100.0.0/24 is subnetted, 1 subnets
B  130.100.200.0 [20/0] via 120.100.6.1, 00:23:06
   150.100.0.0/24 is subnetted, 3 subnets
D  150.100.3.0
   [90/1282560] via 120.100.45.5, 01:29:09, GigabitEthernet0/1.45
D  150.100.1.0 [110/66] via 120.100.34.3, 01:12:04, GigabitEthernet0/0
   120.0.0.0/8 is variably subnetted, 12 subnets, 2 masks
D  120.100.25.0/24
   [110/129] via 120.100.34.3, 01:12:04, GigabitEthernet0/0
C  120.100.4.0/24 is directly connected, Loopback0
D  120.100.5.0/24
   [90/1282560] via 120.100.45.5, 01:29:12, GigabitEthernet0/1.45
D  120.100.6.0/24
   [90/2562560] via 120.100.46.6, 01:29:11, GigabitEthernet0/1.46
D  120.100.1.0/24 [110/66] via 120.100.34.3, 01:25:00, GigabitEthernet0/0
D  120.100.2.0/24 [110/66] via 120.100.34.3, 01:25:00, GigabitEthernet0/0
D  120.100.3.0/24 [110/2] via 120.100.34.3, 01:25:00, GigabitEthernet0/0
C  120.100.45.0/24 is directly connected, GigabitEthernet0/1.45
C  120.100.46.0/24 is directly connected, GigabitEthernet0/1.46
C  120.100.34.0/24 is directly connected, GigabitEthernet0/0
D  120.100.123.0/32
   [110/1] via 120.100.34.3, 01:25:00, GigabitEthernet0/0
D  120.100.123.0/24
   [110/129] via 120.100.34.3, 01:25:00, GigabitEthernet0/0
R4# sh ip route ospf
   150.100.0.0/24 is subnetted, 3 subnets
D  150.100.2.0 [110/66] via 120.100.34.3, 01:12:15, GigabitEthernet0/0

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Lab 1 Router and Switch Configuration Files

0 IA 150.100.1.0 [110/66] via 120.100.34.3, 01:12:15, GigabitEthernet0/0
    120.0.0.0/8 is variably subnetted, 12 subnets, 2 masks
0 IA 120.100.25.0/24
    [110/129] via 120.100.34.3, 01:12:15, GigabitEthernet0/0
0 120.100.1.0/24 [110/66] via 120.100.34.3, 01:25:19, GigabitEthernet0/0
0 120.100.2.0/24 [110/66] via 120.100.34.3, 01:25:19, GigabitEthernet0/0
0 120.100.3.0/24 [110/2] via 120.100.34.3, 01:25:19, GigabitEthernet0/0
0 120.100.123.3/32
    [110/1] via 120.100.34.3, 01:25:19, GigabitEthernet0/0
0 120.100.123.0/24
    [110/129] via 120.100.34.3, 01:25:19, GigabitEthernet0/0

R4# sh ip route eigrp
    150.100.0.0/24 is subnetted, 3 subnets
D 150.100.3.0
    [90/1282560] via 120.100.45.5, 01:29:26, GigabitEthernet0/1.45
    120.0.0.0/8 is variably subnetted, 12 subnets, 2 masks
D 120.100.5.0/24
    [90/1282560] via 120.100.45.5, 01:29:27, GigabitEthernet0/1.45
D 120.100.6.0/24
    [90/2562560] via 120.100.46.6, 01:29:26, GigabitEthernet0/1.46

R4# sh ip bgp
    BGP table version is 17, local router ID is 120.100.4.1
    Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
    r RIB-failure, S Stale
    Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>* 126.1.1.0/24</td>
<td>120.100.6.1</td>
<td>0</td>
<td>300</td>
<td>10</td>
<td>i</td>
</tr>
<tr>
<td>*</td>
<td>120.100.3.1</td>
<td>0</td>
<td>10</td>
<td>i</td>
<td></td>
</tr>
</tbody>
</table>
Lab 1 Router and Switch Configuration Files

* 130.1.1.0/24 120.100.6.1  0 300 10 i
*> 120.100.3.1  0 10 i
*> 130.100.200.0/24 120.100.6.1  0 300 10 i

R# show ipv6 route

IPv6 Routing Table - 12 entries

Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
    U - Per-user Static route
    I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
    O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
    ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
    D - EIGRP, EX - EIGRP external

R 2007::/16 [120/4]
  via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
R 2007:C15:C0:10::/64 [120/3]
  via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
R 2007:C15:C0:11::/64 [120/2]
  via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
R 2007:C15:C0:12::/64 [120/3]
  via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
R 2007:C15:C0:13::/64 [120/3]
  via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
R 2007:C15:C0:14::/64 [120/3]
  via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
C 2007:C15:C0:15::/64 [0/0]
  via ::, GigabitEthernet0/0
L 2007:C15:C0:15::4/128 [0/0]
  via ::, GigabitEthernet0/0
C 2007:C15:C0:17::/64 [0/0]
  via ::, Tunnel0
L 2007:C15:C0:17::4/128 [0/0]
  via ::, Tunnel0
Lab 1 Router and Switch Configuration Files

L FE80::/10 [0/0]
   via ::, Null0
L FF00::8 [0/0]
   via ::, Null0
R4#

Router 5 Initial Configuration

R5# sh run
Building configuration...

Current configuration : 1448 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R5
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
Lab 1 Router and Switch Configuration Files

```plaintext
memory-size ionem 10
ip cef
   |
   |
   |
   |
   |
no ip domain lookup
   |
voice-card 0
   |
   |
   |
   |
   |
   |
   |
   |
   |
   |
no dspfarm
```
interface Loopback0
  ip address 120.100.5.1 255.255.255.0

interface GigabitEthernet0/0
  ip address 120.100.45.5 255.255.255.0
duplex auto
  speed auto
  media-type rj45
  negotiation auto

interface GigabitEthernet0/1
  ip address 150.100.3.5 255.255.255.0
duplex auto
  speed auto
  media-type rj45
  negotiation auto

interface Serial0/0/0
  no ip address
  shutdown

interface Serial0/0/1
  ip address 120.100.25.5 255.255.255.0
  encapsulation frame-relay
  frame-relay map ip 120.100.25.2 512 broadcast
  ip ospf network point-to-point
  no frame-relay inverse-arp

Lab 1 Router and Switch Configuration Files

```
!
!
ip http server
no ip http secure-server
!
!
control-plane
!
!
!
!
!
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!
# Lab 1 Router and Switch Configuration Files

```
line vty 0 4
    exec-timeout 0 0
    password cisco
    logging synchronous
    login
    transport input telnet

! scheduler allocate 20000 1000
!
webvpn context Default_context
    ssl authenticate verify all
!
    no inservice
!
end
```

## Router 5 Final Configuration

```
RS# sh run
Building configuration...

Current configuration : 3387 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
```
hostname R5
!
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionem 10
ip cef
!
!
!
!
no ip domain lookup
ip sla 1
  icmp-echo 120.100.25.5
ip sla schedule 1 life forever start-time now
!
ipv6 unicast-routing
voice-card 0
  no dspfarm
!
!
track 1 rtr 1 reachability

track 2 ip route 130.100.200.0 255.255.255.0 reachability

interface Tunnel0
  no ip address
  ipv6 address 2007:C15:C0:17::5/64
  ipv6 rip CCIE enable
  ipv6 rip CCIE metric-offset 4
  tunnel source GigabitEthernet0/0
  tunnel destination 120.100.45.4
  tunnel mode ipv6ip

interface Loopback0
 ip address 120.100.5.1 255.255.255.0
 ip ospf network point-to-point
 ip ospf 1 area 5
!
interface GigabitEthernet0/0
 ip address 120.100.45.5 255.255.255.0
 ip policy route-map TEST
 ip ospf network non-broadcast
 ip ospf 1 area 5
duplex auto
 speed auto
 media-type rj45
 negotiation auto
!
interface GigabitEthernet0/1
 ip address 150.100.3.5 255.255.255.0
duplex auto
 speed auto
 media-type rj45
 negotiation auto
 ipv6 address 2007:C15:00:16::5/64
 ipv6 ospf flood-reduction
 ipv6 ospf 1 area 0
 standby 1 ip 150.100.3.1
 standby 1 preempt
 standby 1 track 2 decrement 20
!
interface Serial0/0/0
 no ip address
shutdown
!
interface Serial0/0/1
  ip address 120.100.25.5 255.255.255.0
  encapsulation frame-relay
  ip ospf network point-to-point
  ip ospf 1 area 5
  ipv6 address 2007:C15:0:14::5/64
  ipv6 rip CCIE enable
  ipv6 rip CCIE summary-address 2007::/16
  frame-relay map ipv6 2007:C15:0:14::2 512 broadcast
  frame-relay map ipv6 FE80::213:7FF:FE84:BE0 512 broadcast
  frame-relay map ip 120.100.25.2 512 broadcast
  frame-relay map ip 120.100.25.5 512 broadcast
  no frame-relay inverse-arp
!
router eigrp 1
  passive-interface Loopback0
  network 120.100.5.1 0.0.0.0
  network 120.100.45.5 0.0.0.0
  network 150.100.3.5 0.0.0.0
  no auto-summary
!
router ospf 1
  log-adjacency-changes
  neighbor 120.100.45.4
!
router bgp 300
  no synchronization
  bgp log-neighbor-changes
neighbor 120.100.2.1 remote-as 10
neighbor 120.100.2.1 ebgp-multihop 2
neighbor 120.100.2.1 update-source Loopback0
neighbor 120.100.6.1 remote-as 300
neighbor 120.100.6.1 update-source Loopback0
neighbor 120.100.45.6 remote-as 200
neighbor 150.100.3.7 remote-as 300
no auto-summary
!
ip local policy route-map TEST
!
!
ip http server
no ip http secure-server
!
access-list 100 permit ospf host 120.100.45.5 host 120.100.45.4
!
!
ipv6 router ospf 1
  log-adjacency-changes
  redistribute rip CCIE metric 5000 include-connected
!
ipv6 router rip CCIE
  distribute-list prefix-list BLOCK-SUMMARY in Tunnel0
!
!
ipv6 prefix-list BLOCK-SUMMARY seq 10 deny 2007::/16
ipv6 prefix-list BLOCK-SUMMARY seq 15 permit ::/0 le 128
route-map TEST permit 10
  match ip address 100
  set ip next-hop verify-availability 120.100.25.2 10 track 1
  
  control-plane
  
  line con 0
    exec-timeout 0 0
    password cisco
    logging synchronous
    login
    stopbits 1
  line aux 0
    stopbits 1
  line vty 0 4
    exec-timeout 0 0
    password cisco
    logging synchronous
login
transport input telnet
!
scheduler allocate 20000 1000
!
webvpn context Default_context
  ssl authenticate verify all
  
  no inservice
  
  !
end

RS# sh version
Cisco IOS Software, 3800 Software (C3825-ADVENTPRISEK9-M), Version 12.4(6)T,
  RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Thu 23-Feb-06 01:02 by ccai

ROM: System Bootstrap, Version 12.3(11r)T2, RELEASE SOFTWARE (fc1)

RS uptime is 2 hours, 21 minutes
System returned to ROM by reload at 19:17:14 UTC Tue Feb 27 2007
System image file is "flash:c3825-adventureisek9-mz.124-6.T.bin"

This product contains cryptographic features and is subject to UniteB
States and local country laws governing import, export, transfer anB
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If you require further assistance please contact us by sending email to export@cisco.com.

Cisco 3825 (revision 1.0) with 472064K/52224K bytes of memory.
Processor board ID FHK0937FO05
2 Gigabit Ethernet interfaces
2 Serial(sync/async) interfaces
2 Virtual Private Network (VPN) Modules
DRAM configuration is 64 bits wide with parity enabled.
479K bytes of NVRAM.
62720K bytes of ATA System CompactFlash (Read/Write)

Configuration register is 0x2102

R6# sh ip route
Codes: C - connected, S - static, R - RIP, W - mobile, B - BGP
    D - EIGRP, EX - EIGRP external, 0 - OSPF, IA - OSPF inter area
    N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
    E1 - OSPF external type 1, E2 - OSPF external type 2
    i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
Lab 1 Router and Switch Configuration Files

ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

126.0.0.0/24 is subnets, 1 subnets
B 126.1.1.0 [20/0] via 120.100.2.1, 00:25:00
130.1.0.0/24 is subnets, 1 subnets
B 130.1.1.0 [20/0] via 120.100.2.1, 00:24:29
130.100.0.0/24 is subnets, 1 subnets
B 130.100.200.0 [20/0] via 120.100.2.1, 00:24:29
150.100.0.0/24 is subnets, 3 subnets
0 IA 150.100.2.0 [110/65] via 120.100.25.2, 01:11:46, Serial0/0/1
C 150.100.3.0 is directly connected, GigabitEthernet0/1
0 IA 150.100.1.0 [110/193] via 120.100.25.2, 01:11:47, Serial0/0/1
120.0.0.0/8 is variably subnets, 16 subnets, 2 masks
C 120.100.25.0/24 is directly connected, Serial0/0/1
D 120.100.8.0/24
   [90/156160] via 150.100.3.8, 01:30:33, GigabitEthernet0/1
D 120.100.9.0/24
   [90/156160] via 150.100.3.9, 01:30:28, GigabitEthernet0/1
D 120.100.10.0/24
   [90/156160] via 150.100.3.10, 01:30:23, GigabitEthernet0/1
D 120.100.4.0/24
   [90/156160] via 120.100.45.4, 01:30:31, GigabitEthernet0/0
C 120.100.5.0/24 is directly connected, Loopback0
D 120.100.6.0/24
   [90/156160] via 150.100.3.6, 01:30:31, GigabitEthernet0/1
D 120.100.7.0/24
   [90/156160] via 150.100.3.7, 01:30:36, GigabitEthernet0/1
Lab 1 Router and Switch Configuration Files

0 IA 120.100.1.0/24 [110/193] via 120.100.25.2, 01:11:47, Serial0/0/1
0 IA 120.100.2.0/24 [110/65] via 120.100.25.2, 01:11:47, Serial0/0/1
0 IA 120.100.3.0/24 [110/129] via 120.100.25.2, 01:11:48, Serial0/0/1
C 120.100.45.0/24 is directly connected, GigabitEthernet0/0
D 120.100.46.0/24
   [90/30720] via 150.100.3.6, 01:30:33, GigabitEthernet0/1
   [90/30720] via 120.100.45.4, 01:30:33, GigabitEthernet0/0
0 IA 120.100.34.0/24 [110/129] via 120.100.25.2, 01:11:48, Serial0/0/1
0 IA 120.100.123.3/32 [110/128] via 120.100.25.2, 01:11:48, Serial0/0/1
0 IA 120.100.123.0/24 [110/128] via 120.100.25.2, 01:11:48, Serial0/0/1
RS# sh ip route ospf
   150.100.0.0/24 is subnetted, 3 subnets
   0 IA 150.100.2.0 [110/65] via 120.100.25.2, 01:11:53, Serial0/0/1
   0 IA 150.100.1.0 [110/193] via 120.100.25.2, 01:11:53, Serial0/0/1
   120.0.0.0/8 is variably subnetted, 16 subnets, 2 masks
   0 IA 120.100.1.0/24 [110/193] via 120.100.25.2, 01:11:53, Serial0/0/1
   0 IA 120.100.2.0/24 [110/65] via 120.100.25.2, 01:11:53, Serial0/0/1
   0 IA 120.100.3.0/24 [110/129] via 120.100.25.2, 01:11:53, Serial0/0/1
   0 IA 120.100.34.0/24 [110/129] via 120.100.25.2, 01:11:53, Serial0/0/1
   0 IA 120.100.123.3/32 [110/128] via 120.100.25.2, 01:11:53, Serial0/0/1
   0 IA 120.100.123.0/24 [110/128] via 120.100.25.2, 01:11:53, Serial0/0/1
RS# sh ip route eigrp
   120.0.0.0/8 is variably subnetted, 16 subnets, 2 masks
   D 120.100.8.0/24
      [90/156160] via 150.100.3.8, 01:30:43, GigabitEthernet0/1
   D 120.100.9.0/24
      [90/156160] via 150.100.3.9, 01:30:38, GigabitEthernet0/1
   D 120.100.10.0/24
      [90/156160] via 150.100.3.10, 01:30:33, GigabitEthernet0/1
   D 120.100.4.0/24
      [90/156160] via 120.100.45.4, 01:30:42, GigabitEthernet0/0
Lab 1 Router and Switch Configuration Files

D  120.100.6.0/24
   [90/156160] via 150.100.3.6, 01:30:42, GigabitEthernet0/1  
D  120.100.7.0/24
   [90/156160] via 150.100.3.7, 01:30:47, GigabitEthernet0/1  
D  120.100.46.0/24
   [90/30720] via 150.100.3.6, 01:30:42, GigabitEthernet0/1  
   [90/30720] via 120.100.45.4, 01:30:42, GigabitEthernet0/0  

RS# sh ip bgp
BGP table version is 17, local router ID is 120.100.5.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,  
   r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*&gt; 126.1.1.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>10</td>
<td>i</td>
</tr>
<tr>
<td>*&gt; 130.1.1.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>10</td>
<td>i</td>
</tr>
<tr>
<td>*&gt; 130.100.200.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>10</td>
<td>i</td>
</tr>
</tbody>
</table>

RS# sh ipv6 route
IPv6 Routing Table - 13 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP  
   U - Per-user Static route
I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summarization  
0 - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2  
ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2  
D - EIGRP, EX - EIGRP external
R 2007:C15:0:0:10::/64 [120/3]  
   via FE80::213:7FF:FE84:BEE0, Serial0/0/1  
R 2007:C15:0:11::/64 [120/2]  
   via FE80::213:7FF:FE84:BEE0, Serial0/0/1  

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Lab 1 Router and Switch Configuration Files

R 2007:C15:C0:12::/64 [120/2]
   via FE80::213:7FFF:FE84:BEE0, Serial0/0/1
R 2007:C15:C0:13::/64 [120/2]
   via FE80::213:7FFF:FE84:BEE0, Serial0/0/1
C 2007:C15:C0:14::/64 [0/0]
   via ::, Serial0/0/1
L 2007:C15:C0:14::/64 [0/0]
   via ::, Serial0/0/1
R 2007:C15:C0:15::/64 [120/3]
   via FE80::213:7FFF:FE84:BEE0, Serial0/0/1
C 2007:C15:C0:16::/64 [0/0]
   via ::, GigabitEthernet0/1
L 2007:C15:C0:16::/64 [0/0]
   via ::, GigabitEthernet0/1
C 2007:C15:C0:17::/64 [0/0]
   via ::, Tunnel0
L 2007:C15:C0:17::/64 [0/0]
   via ::, Tunnel0
L FE80::/10 [0/0]
   via ::, Null0
L FF00::/8 [0/0]
   via ::, Null0

R5#

Router 6 Initial Configuration

R6# sh run
Building configuration...

Current configuration : 1332 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R6
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionmem 10
ip cef
!
!
!
no ip domain lookup
!
v ME-card 0
no dspfarm
!
!
interface Loopback0
  ip address 120.100.6.1 255.255.255.0
!
interface GigabitEthernet0/0
  ip address 120.100.46.6 255.255.255.0
duplex auto
  speed auto
  media-type rj45
  negotiation auto
  !
interface GigabitEthernet0/1
   ip address 150.100.3.6 255.255.255.0
duplex auto
speed auto
media-type rj45
negotiation auto

interface Serial0/0/0
   no ip address
   shutdown

interface Serial0/0/1
   no ip address
   shutdown

ip http server
no ip http secure-server

control-plane

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Lab 1 Router and Switch Configuration Files

```text
!
!
!
!
!
!
!
!
!
!
line con 0
  exec-timeout 0 0
password cisco
logging synchronous
login
stopbits 1
line aux 0
stopbits 1
line vty 0 4
  exec-timeout 0 0
password cisco
logging synchronous
login
transport input telnet
!
scheduler allocate 20000 1000
!
webvpn context Default_context
  ssl authenticate verify all
!
no inservice
!
end
```
Router 6 Final Configuration

R6# sh run
Building configuration...

Current configuration : 1927 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R6
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionem 10
ip cef
!
!
!
no ip domain lookup
!
ipv6 unicast-routing
voice-card 0
   no dspfarm
!

interface Loopback0
   ip address 120.100.6.1 255.255.255.0
!
Lab 1 Router and Switch Configuration Files

interface GigabitEthernet0/0
  ip address 120.100.46.6 255.255.255.0
duplex auto
  speed auto
  media-type rj45
  negotiation auto

interface GigabitEthernet0/1
  ip address 150.100.3.6 255.255.255.0
duplex auto
  speed auto
  media-type rj45
  negotiation auto
  ipv6 address 2007:C15:C0:16::6/64
  ipv6 ospf flood-reduction
  ipv6 ospf 1 area 0
  standby 1 ip 150.100.3.1
  standby 1 priority 90
  standby 1 preempt

interface Serial0/0/0
  no ip address
  shutdown

interface Serial0/0/1
  no ip address
  shutdown

router eigrp 1
  network 120.100.6.1 0.0.0.0
  network 120.100.46.6 0.0.0.0
Lab 1 Router and Switch Configuration Files

```
network 150.100.3.8 0.0.0.0
no auto-summary

router bgp 300
no synchronization
bgp log-neighbor-changes
neighbor IBGP peer-group
neighbor IBGP remote-as 300
neighbor IBGP update-source Loopback0
neighbor 120.100.4.1 remote-as 200
neighbor 120.100.4.1 ebgp-multihop 2
neighbor 120.100.4.1 update-source Loopback0
neighbor 120.100.5.1 peer-group IBGP
neighbor 150.100.3.7 peer-group IBGP
no auto-summary

ip http server
no ip http secure-server

ipv6 router ospf 1
  log-adjacency-changes
```

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control-plane

line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  transport input telnet

scheduler allocate 20000 1000
webvpn context Default_context
   ssl authenticate verify all
!
   no inservice
!
!
end

RS# sh version
Cisco IOS Software, 3800 Software (C3825-ADVENTERPRISEK9-M), Version 12.4(6)T,
   RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Thu 23-Feb-06 01:02 by ccai

ROM: System Bootstrap, Version 12.3(t11r)T2, RELEASE SOFTWARE (fc1)

RS uptime is 2 hours, 22 minutes
System returned to ROM by reload at 19:09:51 UTC Tue Feb 27 2007
System image file is 'flash:c3825-adventerprisek9-mz.124-6.T.bin'

This product contains cryptographic features and is subject to UniteB
States and local country laws governing import, export, transfer anB
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Cisco 3625 (revision 1.0) with 472064K/52224K bytes of memory.
Processor board ID FHK0937F0R5
2 Gigabit Ethernet interfaces
2 Serial(sync/async) interfaces
2 Virtual Private Network (VPN) Modules
DRAM configuration is 64 bits wide with parity enabled.
479K bytes of NVRAM.
62720K bytes of ATA System CompactFlash (Read/Write)

Configuration register is 0x2102

R6# show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, 0 - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
* - candidate default, U - per-user static route
O - ODR, P - periodic downloaded static route

Gateway of last resort is not set

126.0.0.0/24 is subnetted, 1 subnets
Lab 1 Router and Switch Configuration Files

B  126.1.1.0 [200/0] via 120.100.2.1, 00:28:15
   130.1.0.0/24 is subbed, 1 subnets
B  130.1.1.0 [200/0] via 120.100.2.1, 00:25:45
   130.100.0.0/24 is subbed, 1 subnets
B  130.100.200.0 [200/0] via 120.100.2.1, 00:25:45
   150.100.0.0/24 is subbed, 3 subnets
D EX  150.100.2.0
   [170/284160] via 120.100.46.4, 01:21:26, GigabitEthernet0/0
C  150.100.3.0 is directly connected, GigabitEthernet0/1
D EX  150.100.1.0
   [170/284160] via 120.100.46.4, 01:21:27, GigabitEthernet0/0
   120.0.0.0/8 is variably subbed, 16 subnets, 2 masks
D EX  120.100.25.0/24
   [170/284160] via 120.100.46.4, 01:14:41, GigabitEthernet0/0
D  120.100.8.0/24
   [90/156160] via 150.100.3.8, 01:26:33, GigabitEthernet0/1
D  120.100.9.0/24
   [90/156160] via 150.100.3.9, 01:26:33, GigabitEthernet0/1
D  120.100.10.0/24
   [90/156160] via 150.100.3.10, 01:26:33, GigabitEthernet0/1
D  120.100.4.0/24
   [90/156160] via 120.100.46.4, 01:26:33, GigabitEthernet0/0
D  120.100.5.0/24
   [90/156160] via 150.100.3.5, 01:26:33, GigabitEthernet0/1
C  120.100.6.0/24 is directly connected, Loopback0
D  120.100.7.0/24
   [90/156160] via 150.100.3.7, 01:26:33, GigabitEthernet0/1
D EX  120.100.1.0/24
   [170/284160] via 120.100.46.4, 01:21:28, GigabitEthernet0/0
D EX  120.100.2.0/24
   [170/284160] via 120.100.46.4, 01:21:28, GigabitEthernet0/0
Lab 1 Router and Switch Configuration Files

D EX 120.100.3.0/24
[170/284160] via 120.100.46.4, 01:21:28, GigabitEthernet0/0

D 120.100.45.0/24
[90/30720] via 150.100.3.5, 01:26:34, GigabitEthernet0/1
[90/30720] via 120.100.46.4, 01:26:34, GigabitEthernet0/0

C 120.100.46.0/24 is directly connected, GigabitEthernet0/0

D EX 120.100.34.0/24
[170/284160] via 120.100.46.4, 01:21:30, GigabitEthernet0/0

D EX 120.100.123.0/32
[170/284160] via 120.100.46.4, 01:21:30, GigabitEthernet0/0

D EX 120.100.123.0/24
[170/284160] via 120.100.46.4, 01:21:30, GigabitEthernet0/0

R6# show ip route eigrp
150.100.0.0/24 is subnetted, 3 subnets

D EX 150.100.2.0
[170/284160] via 120.100.46.4, 01:21:39, GigabitEthernet0/0

D EX 150.100.1.0
[170/284160] via 120.100.46.4, 01:21:39, GigabitEthernet0/0
120.0.0.0/8 is variably subnetted, 16 subnets, 2 masks

D EX 120.100.25.0/24
[170/284160] via 120.100.46.4, 01:14:52, GigabitEthernet0/0

D 120.100.8.0/24
[90/156160] via 150.100.3.0, 01:26:43, GigabitEthernet0/1

D 120.100.9.0/24
[90/156160] via 150.100.3.0, 01:26:43, GigabitEthernet0/1

D 120.100.10.0/24
[90/156160] via 150.100.3.10, 01:26:43, GigabitEthernet0/1

D 120.100.4.0/24
[90/156160] via 120.100.46.4, 01:26:43, GigabitEthernet0/0

D 120.100.5.0/24
[90/156160] via 150.100.3.5, 01:26:43, GigabitEthernet0/1
Lab 1 Router and Switch Configuration Files

D  120.100.7.0/24
   [90/156160] via 150.100.3.7, 01:26:43, GigabitEthernet0/1

D EX  120.100.1.0/24
   [170/284160] via 120.100.46.4, 01:21:39, GigabitEthernet0/0

D EX  120.100.2.0/24
   [170/284160] via 120.100.46.4, 01:21:40, GigabitEthernet0/0

D EX  120.100.3.0/24
   [170/284160] via 120.100.46.4, 01:21:40, GigabitEthernet0/0

D  120.100.45.0/24
   [90/30720] via 150.100.3.5, 01:26:44, GigabitEthernet0/1
   [90/30720] via 120.100.46.4, 01:26:44, GigabitEthernet0/0

D EX  120.100.34.0/24
   [170/284160] via 120.100.46.4, 01:21:40, GigabitEthernet0/0

D EX  120.100.123.3/32
   [170/284160] via 120.100.46.4, 01:21:40, GigabitEthernet0/0

D EX  120.100.123.0/24
   [170/284160] via 120.100.46.4, 01:21:40, GigabitEthernet0/0

R6# sh ip bgp
BGP table version is 19, local router ID is 120.100.6.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
               r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
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<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*126.1.1.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>10 i</td>
</tr>
<tr>
<td>*126.1.1.0</td>
<td>120.100.4.1</td>
<td>0</td>
<td>200</td>
<td>0</td>
<td>10 i</td>
</tr>
<tr>
<td>*130.1.1.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>10 i</td>
</tr>
<tr>
<td>*130.1.1.0</td>
<td>120.100.4.1</td>
<td>0</td>
<td>200</td>
<td>0</td>
<td>10 i</td>
</tr>
<tr>
<td>*130.100.200.0/24</td>
<td>120.100.2.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>10 i</td>
</tr>
</tbody>
</table>
Lab 1 Router and Switch Configuration Files

RS# sh ipv6 route
IPv6 Routing Table - 11 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
U - Per-user Static route
I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
D - EIGRP, EX - EIGRP external

OE2 2007:C15::C0:10::/64 [110/5000]
via FE80::214:6AFF:FEFC:F131, GigabitEthernet0/1

OE2 2007:C15::C0:11::/64 [110/5000]
via FE80::214:6AFF:FEFC:F131, GigabitEthernet0/1

OE2 2007:C15::C0:12::/64 [110/5000]
via FE80::214:6AFF:FEFC:F131, GigabitEthernet0/1

OE2 2007:C15::C0:13::/64 [110/5000]
via FE80::214:6AFF:FEFC:F131, GigabitEthernet0/1

OE2 2007:C15::C0:14::/64 [110/5000]
via FE80::214:6AFF:FEFC:F131, GigabitEthernet0/1

OE2 2007:C15::C0:15::/64 [110/5000]
via FE80::214:6AFF:FEFC:F131, GigabitEthernet0/1

C 2007:C15::C0:16::/64 [0/0]
via ::, GigabitEthernet0/1

L 2007:C15::C0:16::6/128 [0/0]
via ::, GigabitEthernet0/1

OE2 2007:C15::C0:17::/64 [110/5000]
via FE80::214:6AFF:FEFC:F131, GigabitEthernet0/1

L FE80::10 [0/0]
via ::, Null0

L FF00::8 [0/0]
via ::, Null0

RS#
Switch Configuration Files

Switch 1 Initial Configuration

SW1# sh run
Building configuration...

Current configuration : 2741 bytes
!
version 12.2
no service pab
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname SW1
!
no logging console
enable password cisco
!
no aaa new-model
ip subnet-zero
no ip domain-lookup
!
vtp domain CCIE
vtp mode transparent
!
!
Lab 1 Router and Switch Configuration Files

!
!
!
no file verify auto
spanning-tree mode pvst
spanning-tree extend system-id
!
vlan internal allocation policy ascending
!
vlan 34,45-46,300
!
!
interface Loopback0
  ip address 120.100.7.1 255.255.255.0
!
interface FastEthernet0/1
  switchport mode dynamic desirable
!
interface FastEthernet0/2
  switchport mode dynamic desirable
!
interface FastEthernet0/3
  switchport access vlan 34
  switchport mode access
!
interface FastEthernet0/4
  switchport access vlan 34
  switchport mode access
interface FastEthernet0/5
  switchport access vlan 45
  switchport mode access

interface FastEthernet0/6
  switchport access vlan 46
  switchport mode access

interface FastEthernet0/7
  switchport mode dynamic desirable

interface FastEthernet0/8
  switchport mode dynamic desirable

interface FastEthernet0/9
  switchport mode dynamic desirable

interface FastEthernet0/10
  switchport mode dynamic desirable

interface FastEthernet0/11
  switchport mode dynamic desirable

interface FastEthernet0/12
  switchport mode dynamic desirable

interface FastEthernet0/13
  switchport mode dynamic desirable

interface FastEthernet0/14
  switchport mode dynamic desirable

interface FastEthernet0/15
  switchport mode dynamic desirable

interface FastEthernet0/16
  switchport mode dynamic desirable

interface FastEthernet0/17
  switchport mode dynamic desirable

interface FastEthernet0/18
  switchport mode dynamic desirable

interface FastEthernet0/19
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/20
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/21
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/22
  switchport trunk encapsulation dot1q
  switchport mode trunk
interface FastEthernet0/23
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/24
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface GigabitEthernet0/1
  switchport mode dynamic desirable

interface GigabitEthernet0/2
  switchport mode dynamic desirable

interface Vlan1
  no ip address
  shutdown

interface Vlan300
  ip address 150.100.3.7 255.255.255.0

  ip classless
  ip http server
  ip http secure-server

  control-plane

Lab 1 Router and Switch Configuration Files

line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
line vty 0 4
  no login
line vty 5 15
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  transport input telnet
!
end

Switch 1 Final Configuration

```
SW1# sh run
Building configuration...

Current configuration : 5444 bytes
!
version 12.2
no service pab
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
```
hostname SW1
!
no logging console
enable password cisco
!
no aaa new-model
errdisable recovery cause link-flap
errdisable recovery interval 35
mls qos map policed-dscp 10 16 24 32 34 46 48 to 8
mls qos map dscp-mutation AF43-T0-AF42 38 to 36
mls qos
ip subnet-zero
ip routing
no ip domain-lookup
!
ip dhcp snooping vlan 300
ip dhcp snooping
vtp domain CCIE
vtp mode transparent
!
!
!
!
port-channel load-balance dst-mac
no file verify auto
!
spanning-tree mode rapid-pvst
spanning-tree extend system-id
spanning-tree vlan 1,300 priority 24576
!
Lab 1 Router and Switch Configuration Files

```
vlan internal allocation policy ascending
!
vlan 34,45-46,300
!
class-map match-all POLICE
  match access-group 1
!
!
policy-map RE-MARK
  class POLICE
    police 500000 8000 exceed-action policed-dscp-transmit
    trust dscp
!
!
interface Loopback0
  ip address 120.100.7.1 255.255.255.0
!
interface Port-channel1
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface Port-channel2
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface Port-channel3
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
```
interface FastEthernet0/1
  switchport mode dynamic desirable
  service-policy input RE-MARK

interface FastEthernet0/2
  switchport mode dynamic desirable
  service-policy input RE-MARK

interface FastEthernet0/3
  switchport access vlan 34
  switchport mode access
  service-policy input RE-MARK

interface FastEthernet0/4
  switchport access vlan 34
  switchport mode access
  service-policy input RE-MARK

interface FastEthernet0/5
  switchport access vlan 45
  switchport mode access
  service-policy input RE-MARK

interface FastEthernet0/6
  switchport access vlan 46
  switchport mode access
  service-policy input RE-MARK

interface FastEthernet0/7
  switchport mode dynamic desirable
  service-policy input RE-WARK
!
interface FastEthernet0/8
  switchport mode dynamic desirable
  service-policy input RE-WARK
!
interface FastEthernet0/9
  switchport mode dynamic desirable
  service-policy input RE-WARK
!
interface FastEthernet0/10
  switchport mode dynamic desirable
  service-policy input RE-WARK
!
interface FastEthernet0/11
  switchport access vlan 300
  switchport mode access
  service-policy input RE-WARK
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10
!
interface FastEthernet0/12
  switchport access vlan 300
  switchport mode access
  service-policy input RE-WARK
  spanning-tree portfast
ip verify source
ip dhcp snooping limit rate 10
!
interface FastEthernet0/13
  switchport access vlan 300
  switchport mode access
  service-policy input RE-WARK
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10
  
interface FastEthernet0/14
  switchport access vlan 300
  switchport mode access
  service-policy input RE-WARK
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10
  
interface FastEthernet0/15
  switchport access vlan 300
  switchport mode access
  service-policy input RE-WARK
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10
  
interface FastEthernet0/16
  switchport access vlan 300
  switchport mode access
Lab 1 Router and Switch Configuration Files

```
service-policy input RE-MARK
spanning-tree portfast
ip verify source
ip dhcp snooping limit rate 10
!
interface FastEthernet0/17
switchport access vlan 300
switchport mode access
service-policy input RE-MARK
spanning-tree portfast
ip verify source
ip dhcp snooping limit rate 10
!
interface FastEthernet0/18
switchport access vlan 300
switchport mode access
service-policy input RE-MARK
spanning-tree portfast
ip dhcp snooping trust
!
interface FastEthernet0/19
switchport trunk encapsulation dot1q
switchport mode trunk
service-policy input RE-MARK
channel-group 1 mode on
!
interface FastEthernet0/20
switchport trunk encapsulation dot1q
switchport mode trunk
```
Lab 1 Router and Switch Configuration Files

```
service-policy input RE-MARK
channel-group 1 mode on
!
interface FastEthernet0/21
switchport trunk encapsulation dot1q
switchport mode trunk
service-policy input RE-MARK
channel-group 2 mode on
!
interface FastEthernet0/22
switchport trunk encapsulation dot1q
switchport mode trunk
service-policy input RE-MARK
channel-group 2 mode on
!
interface FastEthernet0/23
switchport trunk encapsulation dot1q
switchport mode trunk
service-policy input RE-MARK
channel-group 3 mode on
!
interface FastEthernet0/24
switchport trunk encapsulation dot1q
switchport mode trunk
service-policy input RE-MARK
channel-group 3 mode on
!
interface GigabitEthernet0/1
switchport mode dynamic desirable
```
Lab 1 Router and Switch Configuration Files

```
mls qos trust dscp
mls qos dscp-mutation AF43-T0-AF42
!
interface GigabitEthernet0/2
    switchport mode dynamic desirable
!
interface Vlan1
    no ip address
    shutdown
!
interface Vlan300
    ip address 150.100.3.7 255.255.255.0
!
router eigrp 1
    network 120.100.7.1 0.0.0.0
    network 150.100.3.7 0.0.0.0
    no auto-summary
!
router bgp 300
    no synchronization
    bgp log-neighbor-changes
    neighbor IBGP peer-group
    neighbor IBGP remote-as 300
    neighbor 120.100.5.1 peer-group IBGP
    neighbor 120.100.6.1 peer-group IBGP
    no auto-summary
!
ip classless
ip http server
```
Lab 1 Router and Switch Configuration Files

```
ip http secure-server
!
!
access-list 1 permit any
!
control-plane
!
!
line con 0
exec-timeout 0 0
password cisco
logging synchronous
login
line vty 0 4
no login
line vty 5 15
exec-timeout 0 0
password cisco
logging synchronous
login
transport input telnet
!
end
```

SW1# sh version
Cisco IOS Software, C3550 Software (C3550-IPSERCESK9-M), Version 12.2(25)SEE,
RELEASE SOFTWARE (fc2)
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Lab 1 Router and Switch Configuration Files

Compiled Fri 03-Feb-06 07:24 by antonino
Image text-base: 0x00003000, data-base: 0x000DBF628

ROM: Bootstrap program is C3550 boot loader

SW1 uptime is 2 hours, 27 minutes
System returned to ROM by power-on
System image file is 'flash:/c3550-ipservicesk9-mz.122-25.SEE.bin'

This product contains cryptographic features and is subject to UniteB
States and local country laws governing import, export, transfer anB
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:

If you require further assistance please contact us by sending email to
export@cisco.com.

Cisco WS-C3550-24 (PowerPC) processor (revision P0) with 65526K/8192K bytes of
memory.
Processor board ID CAT0911X17K
Last reset from warm-reset
Running Layer2/3 Switching Image
Lab 1 Router and Switch Configuration Files

Ethernet-controller 1 has 12 Fast Ethernet/IEEE 802.3 interfaces

Ethernet-controller 2 has 12 Fast Ethernet/IEEE 802.3 interfaces

Ethernet-controller 3 has 1 Gigabit Ethernet/IEEE 802.3 interface

Ethernet-controller 4 has 1 Gigabit Ethernet/IEEE 802.3 interface

24 FastEthernet interfaces
2 Gigabit Ethernet interfaces

The password-recovery mechanism is enabled.

384K bytes of flash-simulated NVRAM.
Base ethernet MAC Address: 00:13:08:60:94:00
Motherboard assembly number: 73-5700-12
Power supply part number: 34-0966-04
Motherboard serial number: CAT09111RK
Power supply serial number: DTH00075GSX
Model revision number: P0
Motherboard revision number: A0
Model number: WS-C3560-24-SMI
System serial number: CAT0911X17K
Configuration register is 0x10F

SW1# show ip route
Codes: C - connected, S - static, R - RIP, W - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

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Lab 1 Router and Switch Configuration Files

ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

126.0.0.0/24 is subnetted, 1 subnets
B  126.1.1.0 [200/0] via 120.100.2.1, 00:27:40
130.1.0.0/24 is subnetted, 1 subnets
B  130.1.1.0 [200/0] via 120.100.2.1, 00:27:10
130.100.0.0/24 is subnetted, 1 subnets
B  130.100.200.0 [200/0] via 120.100.2.1, 00:27:10
150.100.0.0/24 is subnetted, 3 subnets
D EX 150.100.2.0 [170/284416] via 150.100.3.6, 01:22:25, Vlan300
C  150.100.3.0 is directly connected, Vlan300
D EX 150.100.1.0 [170/284416] via 150.100.3.6, 01:22:25, Vlan300
120.0.0.0/8 is variably subnetted, 16 subnets, 2 masks
D EX 120.100.25.0/24 [170/284416] via 150.100.3.6, 01:16:05, Vlan300
D  120.100.8.0/24 [90/130816] via 150.100.3.8, 01:33:30, Vlan300
D  120.100.9.0/24 [90/130816] via 150.100.3.9, 01:33:07, Vlan300
D  120.100.10.0/24 [90/130816] via 150.100.3.10, 01:33:02, Vlan300
D  120.100.4.0/24 [90/156416] via 150.100.3.6, 01:33:11, Vlan300
[90/156416] via 150.100.3.5, 01:33:11, Vlan300
D  120.100.5.0/24 [90/130816] via 150.100.3.5, 01:33:16, Vlan300
D  120.100.6.0/24 [90/130816] via 150.100.3.6, 01:33:16, Vlan300
C  120.100.7.0/24 is directly connected, Loopback0
D EX 120.100.1.0/24 [170/284416] via 150.100.3.6, 01:22:27, Vlan300
D EX 120.100.2.0/24 [170/284416] via 150.100.3.6, 01:22:27, Vlan300
D EX 120.100.3.0/24 [170/284416] via 150.100.3.6, 01:22:27, Vlan300
D  120.100.45.0/24 [90/28416] via 150.100.3.5, 01:33:17, Vlan300
D  120.100.46.0/24 [90/28416] via 150.100.3.6, 01:33:17, Vlan300
Lab 1 Router and Switch Configuration Files

D EX 120.100.34.0/24 [170/284416] via 150.100.3.6, 01:22:27, Vlan300
D EX 120.100.123.3/32 [170/284416] via 150.100.3.6, 01:22:27, Vlan300
D EX 120.100.123.0/24 [170/284416] via 150.100.3.6, 01:22:28, Vlan300
SN1# sh ip route eigrp
150.100.0.0/24 is subbed, 3 subnets
D EX 150.100.2.0 [170/284416] via 150.100.3.6, 01:22:31, Vlan300
D EX 150.100.1.0 [170/284416] via 150.100.3.6, 01:22:31, Vlan300
120.0.0.0/8 is variably subnetted, 16 subnets, 2 masks
D EX 120.100.25.0/24 [170/284416] via 150.100.3.6, 01:16:10, Vlan300
D 120.100.8.0/24 [100/130816] via 150.100.3.6, 01:33:36, Vlan300
D 120.100.9.0/24 [100/130816] via 150.100.3.9, 01:33:12, Vlan300
D 120.100.10.0/24 [100/130816] via 150.100.3.10, 01:33:07, Vlan300
D 120.100.4.0/24 [100/165416] via 150.100.3.6, 01:33:17, Vlan300
D 120.100.1.0/24 [100/165416] via 150.100.3.5, 01:33:17, Vlan300
D 120.100.5.0/24 [100/130816] via 150.100.3.5, 01:33:22, Vlan300
D 120.100.6.0/24 [100/130816] via 150.100.3.6, 01:33:22, Vlan300
D EX 120.100.1.0/24 [170/284416] via 150.100.3.6, 01:22:32, Vlan300
D EX 120.100.2.0/24 [170/284416] via 150.100.3.6, 01:22:32, Vlan300
D EX 120.100.3.0/24 [170/284416] via 150.100.3.6, 01:22:32, Vlan300
D 120.100.45.0/24 [90/284416] via 150.100.3.5, 01:33:22, Vlan300
D 120.100.46.0/24 [90/284416] via 150.100.3.6, 01:33:22, Vlan300
D EX 120.100.34.0/24 [170/284416] via 150.100.3.6, 01:22:33, Vlan300
D EX 120.100.123.3/32 [170/284416] via 150.100.3.6, 01:22:33, Vlan300
D EX 120.100.123.0/24 [170/284416] via 150.100.3.6, 01:22:33, Vlan300
SN1# sh ip bgp
BGP table version is 19, local router ID is 120.100.7.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

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### Lab 1 Router and Switch Configuration Files

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric LocPrf Weight Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*10.1.1.0/24</td>
<td>120.100.2.1</td>
<td>0 100 0 10 i</td>
</tr>
<tr>
<td>*10.1.1.0/24</td>
<td>120.100.2.1</td>
<td>0 100 0 10 i</td>
</tr>
<tr>
<td>*10.1.0.2/24</td>
<td>120.100.2.1</td>
<td>0 100 0 10 i</td>
</tr>
</tbody>
</table>

**SW1# sh spanning-tree summary**

Switch is in rapid-pvst mode

Root bridge for: VLAN0001, VLAN0034, VLAN0045-VLAN0046, VLAN00300

Extended system ID is enableB
Portfast Default is disableB
PortFast BPDU Guard Default is disableB
Portfast BPDU Filter Default is disableB
Loopguard Default is disableB
EtherChannel misconfig guard is enableB
UplinkFast is disableB
BackboneFast is disableB
Configured Pathcost method used is short

<table>
<thead>
<tr>
<th>Name</th>
<th>Blocking</th>
<th>Listening</th>
<th>Learning</th>
<th>Forwarding</th>
<th>STP Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLAN0001</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>VLAN0034</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>VLAN0045</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>VLAN0046</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>VLAN00300</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

5 vlans 0 0 0 21 21

**SW1#**
Switch 2 Initial Configuration

SW2# sh run
Building configuration...

Current configuration : 2258 bytes
!
version 12.2
no service pab
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname SW2
!
no logging console
enable password cisco
!
no aaa new-model
vtp domain CCIE
vtp mode transparent
ip subnet-zero
no ip domain-lookup
!
!
no file verify auto
spanning-tree mode pvst
spanning-tree extend system-id

! vlan internal allocation policy ascending
! vlan 100,200,300
!
! interface Loopback0
   ip address 120.100.8.1 255.255.255.0
!
! interface FastEthernet0/1
   switchport access vlan 100
   switchport mode access
!
! interface FastEthernet0/2
   switchport access vlan 200
   switchport mode access
!
! interface FastEthernet0/3
!
! interface FastEthernet0/4
!
! interface FastEthernet0/5
   switchport access vlan 300
   switchport mode access
!
interface FastEthernet0/6
  switchport access vlan 300
  switchport mode access

interface FastEthernet0/7

interface FastEthernet0/8

interface FastEthernet0/9

interface FastEthernet0/10

interface FastEthernet0/11

interface FastEthernet0/12

interface FastEthernet0/13

interface FastEthernet0/14

interface FastEthernet0/15

interface FastEthernet0/16

interface FastEthernet0/17

interface FastEthernet0/18

Lab 1 Router and Switch Configuration Files

interface FastEthernet0/19
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/20
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/21
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/22
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/23
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/24
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface GigabitEthernet0/1
  switchport mode dynamic desirable

interface GigabitEthernet0/2
  switchport mode dynamic desirable
interface Vlan1
   no ip address
   shutdown

interface Vlan300
   ip address 150.100.3.8 255.255.255.0

ip classless
ip http server
ip http secure-server

control-plane

line con 0
   exec-timeout 0 0
   password cisco
   logging synchronous
   login
line vty 0 4
   no login
line vty 5 15
   exec-timeout 0 0
   password cisco
   logging synchronous
   login
   transport input telnet

end
Switch 2 Final Configuration

SW2# sh run
Building configuration...

Current configuration : 3985 bytes
!
version 12.2
no service pab
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname SW2
!
no logging console
enable password cisco
!
no aaa new-model
vtp domain CCIE
vtp mode transparent
ip subnet-zero
ip routing
no ip domain-lookup
!
ip dhcp snooping vlan 300
ip dhcp snooping
!
!
Lab 1 Router and Switch Configuration Files

!
!
no disable recovery cause link-flap
no disable recovery interval 35
port-channel load-balance dst-mac
no file verify auto
!
spanning-tree mode rapid-pvst
spanning-tree extend system-id
spanning-tree vlan 1,300 priority 28672
!
vlan internal allocation policy ascending
!
vlan 45-46,100,200,300
!
!
interface Loopback0
  ip address 120.100.8.1 255.255.255.0
!
interface Port-channel1
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface Port-channel2
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
Lab 1 Router and Switch Configuration Files

interface Port-channel3
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/1
  switchport access vlan 100
  switchport mode access
!
interface FastEthernet0/2
  switchport access vlan 200
  switchport mode access
!
interface FastEthernet0/3
!
interface FastEthernet0/4
  switchport trunk encapsulation dot1q
  switchport trunk allowed vlan 45,46
  switchport mode trunk
!
interface FastEthernet0/5
  switchport access vlan 300
  switchport mode access
!
interface FastEthernet0/6
  switchport access vlan 300
  switchport mode access
!
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
interface FastEthernet0/10
!
interface FastEthernet0/11
  switchport access vlan 300
  switchport mode access
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10
!
interface FastEthernet0/12
  switchport access vlan 300
  switchport mode access
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10
!
interface FastEthernet0/13
  switchport access vlan 300
  switchport mode access
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10
!
interface FastEthernet0/14
  switchport access vlan 300
  switchport mode access
spanning-tree portfast
ip verify source
ip dhcp snooping limit rate 10
!
interface FastEthernet0/15
  switchport access vlan 300
  switchport mode access
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10
  
interface FastEthernet0/16
  switchport access vlan 300
  switchport mode access
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10
  
interface FastEthernet0/17
  switchport access vlan 300
  switchport mode access
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10
  
interface FastEthernet0/18

interface FastEthernet0/19
  switchport trunk encapsulation dot1q
switchport mode trunk
channel-group 1 mode on
!
interface FastEthernet0/20
  switchport trunk encapsulation dot1q
  switchport mode trunk
  channel-group 1 mode on
!
interface FastEthernet0/21
  switchport trunk encapsulation dot1q
  switchport mode trunk
  channel-group 2 mode on
!
interface FastEthernet0/22
  switchport trunk encapsulation dot1q
  switchport mode trunk
  channel-group 2 mode on
!
interface FastEthernet0/23
  switchport trunk encapsulation dot1q
  switchport mode trunk
  channel-group 3 mode on
!
interface FastEthernet0/24
  switchport trunk encapsulation dot1q
  switchport mode trunk
  channel-group 3 mode on
!
interface GigabitEthernet0/1
  switchport mode dynamic desirable
!
interface GigabitEthernet0/2
  switchport mode dynamic desirable
!
interface Vlan1
  no ip address
  shutdown
!
interface Vlan45
  no ip address
!
interface Vlan300
  ip address 150.100.3.8 255.255.255.0
!
routing eigrp 1
  network 120.100.8.1 0.0.0.0
  network 150.100.3.8 0.0.0.0
  no auto-summary
!
ip classless
ip http server
ip http secure-server
!
!
control-plane
!
!
line con 0
  exec-timeout 0 0
password cisco
Lab 1 Router and Switch Configuration Files

```
logging synchronous
login
line vty 0 4
no login
line vty 5 15
exec-timeout 0 0
password cisco
logging synchronous
login
transport input telnet
!
end
```

SW2# sh ver
Cisco IOS Software, C3560 Software (C3560-IPSERVICSK9-M), Version 12.2(25)SEE,
RELEASE SOFTWARE (fc2)
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Fri 03-Feb-06 07:38 by antonino
Image text-base: 0x00003000, data-base: 0x011C5930

ROM: Bootstrap program is C3560 boot loader
BOOTLDR: C3560 Boot Loader (C3560-HBOOT-M) Version 12.2(25r)SEA, RELEASE SOFTWARE
(fc)

SW2 uptime is 2 hours, 29 minutes
System returned to ROM by power-on
System image file is 'flash:/c3560-ipservicenk9-mz.122-25.SEE.bin'
This product contains cryptographic features and is subject to United States and local country laws governing import, export, transfer and use. Delivery of Cisco cryptographic products does not imply third-party authority to import, export, distribute or use encryption. Importers, exporters, distributors and users are responsible for compliance with U.S. and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:

If you require further assistance please contact us by sending email to export@cisco.com.

cisco WS-C3560-24PS (PowerPC405) processor (revision N0) with 118784K/12280K bytes of memory.
Processor board ID CAT0035N20Q
Last reset from power-on
3 Virtual Ethernet interfaces
24 FastEthernet interfaces
2 Gigabit Ethernet interfaces
The password-recovery mechanism is enabled.

512K bytes of flash-simulated non-volatile configuration memory.
Base ethernet MAC Address : 00:15:62:85:B8:00
Motherboard assembly number : 73-9673-06
Power supply part number : 341-0029-04
Motherboard serial number : CAT0035GJG
Power supply serial number : DTH093109MQ
### Lab 1 Router and Switch Configuration Files

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<tr>
<td>Model number</td>
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<tr>
<td>System serial number</td>
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<td>: 800-25861-03</td>
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<td>CLEI Code Number</td>
<td>: COM1X0@ARB</td>
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<td>Hardware Board Revision Number</td>
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<table>
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<th>Ports</th>
<th>Model</th>
<th>SW Version</th>
<th>SW Image</th>
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<td>*</td>
<td>1 26</td>
<td>WS-C3560-24PS</td>
<td>12.2(25)SEE</td>
<td>C3560-IPSERVICESK9-M</td>
</tr>
</tbody>
</table>

Configuration register is 0xF

```
SW2# sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       IA - IS-IS inter area, * - candidate default, U - per-user static route
       O - ODR, P - periodic downloaded static route
Gateway of last resort is not set
```
Lab 1 Router and Switch Configuration Files

150.100.0.0/24 is subnetted, 3 subnets
D EX 150.100.2.0 [170/284416] via 150.100.3.6, 01:23:57, Vlan300
C 150.100.3.0 is directly connected, Vlan300
D EX 150.100.1.0 [170/284416] via 150.100.3.6, 01:23:57, Vlan300
120.0.0.0/8 is variably subnetted, 16 subnets, 2 masks
D EX 120.100.25.0/24 [170/284416] via 150.100.3.6, 01:17:36, Vlan300
C 120.100.8.0/24 is directly connected, Loopback0
D 120.100.9.0/24 [00/130816] via 150.100.3.9, 01:34:38, Vlan300
D 120.100.10.0/24 [00/130816] via 150.100.3.10, 01:34:34, Vlan300
D 120.100.4.0/24 [00/16416] via 150.100.3.6, 01:34:43, Vlan300
[00/16416] via 150.100.3.5, 01:34:43, Vlan300
D 120.100.5.0/24 [00/130816] via 150.100.3.5, 01:34:45, Vlan300
D 120.100.6.0/24 [00/130816] via 150.100.3.6, 01:34:48, Vlan300
D 120.100.7.0/24 [00/130816] via 150.100.3.7, 01:35:02, Vlan300
D EX 120.100.1.0/24 [170/284416] via 150.100.3.6, 01:23:59, Vlan300
D EX 120.100.2.0/24 [170/284416] via 150.100.3.6, 01:23:59, Vlan300
D EX 120.100.3.0/24 [170/284416] via 150.100.3.6, 01:23:59, Vlan300
D 120.100.45.0/24 [00/28416] via 150.100.3.5, 01:34:46, Vlan300
D 120.100.46.0/24 [00/28416] via 150.100.3.6, 01:34:49, Vlan300
D EX 120.100.34.0/24 [170/284416] via 150.100.3.6, 01:23:59, Vlan300
D EX 120.100.123.3/32 [170/284416] via 150.100.3.6, 01:23:59, Vlan300
D EX 120.100.123.0/24 [170/284416] via 150.100.3.6, 01:23:59, Vlan300

Switch 3 Initial Configuration

SW3# sh run
Building configuration...

Current configuration : 1902 bytes
!
version 12.2
no service pab
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname SW3
!
no logging console
enable password cisco
!
no aaa new-model
vtp domain CCIE
vtp mode transparent
ip subnet-zero
no ip domain-lookup
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
no file verify auto
spanning-tree mode pvst
spanning-tree extend system-id
!
vlan internal allocation policy ascending
!
vlan 300
!
interface Loopback0
  ip address 120.100.9.1 255.255.255.0
|
interface FastEthernet0/1
|
interface FastEthernet0/2
|
interface FastEthernet0/3
|
interface FastEthernet0/4
|
interface FastEthernet0/5
|
interface FastEthernet0/6
|
interface FastEthernet0/7
|
interface FastEthernet0/8
|
interface FastEthernet0/9
|
interface FastEthernet0/10
|
interface FastEthernet0/11
|
interface FastEthernet0/12
|
interface FastEthernet0/13
|
Lab 1 Router and Switch Configuration Files

interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/20
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/21
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/22
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/23
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/24
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
  no ip address
  shutdown
!
interface Vlan300
  ip address 150.100.3.9 255.255.255.0
!
ip classless
ip http server
ip http secure-server
!
!
control-plane
!
!
line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
line vty 0 4
  no login
Lab 1 Router and Switch Configuration Files

```plaintext
line vty 5 15
    exec-timeout 0 0
    password cisco
    logging synchronous
    login
    transport input telnet
end
```

**Switch 3 Final Configuration**

```plaintext
SW3# sh run
Building configuration...

Current configuration : 3306 bytes
!
version 12.2
no service pab
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname SW3
!
no logging console
enable password cisco
!
no aaa new-model
vtp domain CCIE
```

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Lab 1 Router and Switch Configuration Files

vtp mode transparent
ip subnet-zero
ip routing
no ip domain-lookup
!
ip dhcp snooping vlan 300
ip dhcp snooping
!
!
!
!
errdisable recovery cause link-flap
errdisable recovery interval 35
port-channel load-balance dst-mac
no file verify auto
spanning-tree mode pvst
spanning-tree extend system-id
!
vlan internal allocation policy ascending
!
vlan 300
!
!
interface Loopback0
   ip address 120.100.9.1 255.255.255.0
!
interface Port-channel1
   switchport trunk encapsulation dot1q
   switchport mode trunk
!
interface Port-channel2
    switchport trunk encapsulation dot1q
    switchport mode trunk

interface FastEthernet0/1

interface FastEthernet0/2

interface FastEthernet0/3

interface FastEthernet0/4

interface FastEthernet0/5

interface FastEthernet0/6

interface FastEthernet0/7

interface FastEthernet0/8

interface FastEthernet0/9

interface FastEthernet0/10

interface FastEthernet0/11
    switchport access vlan 300
    switchport mode access
    spanning-tree portfast
    ip verify source
    ip dhcp snooping limit rate 10

Lab 1 Router and Switch Configuration Files

```
interface FastEthernet0/12
  switchport access vlan 300
  switchport mode access
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10

interface FastEthernet0/13
  switchport access vlan 300
  switchport mode access
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10

interface FastEthernet0/14
  switchport access vlan 300
  switchport mode access
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10

interface FastEthernet0/15
  switchport access vlan 300
  switchport mode access
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10

interface FastEthernet0/16
  switchport access vlan 300
```
switchport mode access
spanning-tree portfast
ip verify source
ip dhcp snooping limit rate 10

interface FastEthernet0/17
switchport access vlan 300
switchport mode access
spanning-tree portfast
ip verify source
ip dhcp snooping limit rate 10

interface FastEthernet0/18

interface FastEthernet0/19
switchport trunk encapsulation dot1q
switchport mode trunk
channel-group 1 mode on

interface FastEthernet0/20
switchport trunk encapsulation dot1q
switchport mode trunk
channel-group 1 mode on

interface FastEthernet0/21
switchport trunk encapsulation dot1q
switchport mode trunk
channel-group 2 mode on

interface FastEthernet0/22
    switchport trunk encapsulation dot1q
    switchport mode trunk
    channel-group 2 mode on
!
interface FastEthernet0/23
    switchport trunk encapsulation dot1q
    switchport mode trunk
    shutdown
!
interface FastEthernet0/24
    switchport trunk encapsulation dot1q
    switchport mode trunk
    shutdown
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
    no ip address
    shutdown
!
interface Vlan300
    ip address 150.100.3.9 255.255.255.0
!
router eigrp 1
    network 120.100.0.1 0.0.0.0
    network 150.100.3.9 0.0.0.0
    no auto-summary
!
Lab 1 Router and Switch Configuration Files

ip classless
ip http server
ip http secure-server
!
!
control-plane
!
!
line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
line vty 0 4
  no login
line vty 5 15
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  transport input telnet
!
end

SW3# sh version
Cisco IOS Software, C3560 Software (C3560-IPSERVICESK9-M), Version 12.2(25)SEE,
RELEASE SOFTWARE (fc2)
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Compiled Fri 03-Feb-06 07:38 by antonino
Image text-base: $0x00003000$, data-base: $0x011C930$

ROM: Bootstrap program is C3560 boot loader
BOOTLDR: C3560 Boot Loader (C3560-HBOOT-M) Version 12.2(25r)SEA, RELEASE SOFTWARE (fc)

SW3 uptime is 2 hours, 29 minutes
System returned to ROM by power-on
System image file is '/flash:/c3560-ipservicesk9-mz.122-25.SEE.bin'

This product contains cryptographic features and is subject to United States and local country laws governing import, export, transfer and use. Delivery of Cisco cryptographic products does not imply third-party authority to import, export, distribute or use encryption. Importers, exporters, distributors and users are responsible for compliance with U.S. and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return this product immediately.

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If you require further assistance please contact us by sending email to export@cisco.com.

cisco WS-C3560-24PS (PowerPC405) processor (revision N0) with 118784K/12280K bytes of memory.
Processor board ID CAT0935N3LB
Lab 1 Router and Switch Configuration Files

Last reset from power-on
2 Virtual Ethernet interfaces
24 FastEthernet interfaces
2 Gigabit Ethernet interfaces
The password-recovery mechanism is enabled.

512K bytes of flash-simulated non-volatile configuration memory.
Base ethernet MAC Address : 00:15:62:86:58:00
Motherboard assembly number : 73-9673-06
Power supply part number : 341-0029-04
Motherboard serial number : CAT093604XY
Power supply serial number : DTH093188C4
Model revision number : N0
Motherboard revision number : A0
Model number : WS-C3560-24PS-S
System serial number : CAT0935N3LB
Top Assembly Part Number : 800-25861-03
Top Assembly Revision Number : B0
Version ID : V05
CLEI Code Number : COM1X00ARB
Hardware Board Revision Number : 0x01

<table>
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<tr>
<th>Switch</th>
<th>Ports</th>
<th>Model</th>
<th>SW Version</th>
<th>SW Image</th>
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<td>12.2(25)SEE</td>
<td>C3560-IPSERVICESK9-M</td>
</tr>
</tbody>
</table>

Configuration register is 0xF
SW3# show ip route

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
L1 - IS-IS level-1, L2 - IS-IS level-2
I - IS-IS inter area, * - candidate default, U - per-user static route
O - ODR, P - periodic downloaded static route

Gateway of last resort is not set

150.100.0.0/8 is subnetted, 3 subnets
D EX 150.100.2.0 [170/284416] via 150.100.3.6, 01:25:04, Vlan300
C 150.100.3.0 is directly connected, Vlan300
D EX 150.100.1.0 [170/284416] via 150.100.3.6, 01:25:04, Vlan300
120.0.0.0/8 is variably subnetted, 16 subnets, 2 masks
D EX 120.100.25.0/24 [170/284416] via 150.100.3.6, 01:18:43, Vlan300
D 120.100.8.0/24 [90/130816] via 150.100.3.8, 01:35:44, Vlan300
C 120.100.9.0/24 is directly connected, Loopback0
D 120.100.10.0/24 [90/130816] via 150.100.3.10, 01:35:42, Vlan300
D 120.100.4.0/24 [90/156416] via 150.100.3.6, 01:35:42, Vlan300
[90/156416] via 150.100.3.6, 01:35:44, Vlan300
[90/156416] via 150.100.3.5, 01:35:44, Vlan300
D 120.100.5.0/24 [90/130816] via 150.100.3.5, 01:35:44, Vlan300
D 120.100.6.0/24 [90/130816] via 150.100.3.6, 01:35:44, Vlan300
D 120.100.7.0/24 [90/130816] via 150.100.3.7, 01:35:46, Vlan300
D EX 120.100.1.0/24 [170/284416] via 150.100.3.6, 01:25:06, Vlan300
D EX 120.100.2.0/24 [170/284416] via 150.100.3.6, 01:25:06, Vlan300
D EX 120.100.3.0/24 [170/284416] via 150.100.3.6, 01:25:06, Vlan300
D 120.100.45.0/24 [90/284416] via 150.100.3.5, 01:35:45, Vlan300
D 120.100.46.0/24 [90/284416] via 150.100.3.6, 01:35:46, Vlan300

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Switch 4 Initial Configuration

SW4# sh run
Building configuration...

Current configuration : 1903 bytes
!
version 12.2
no service password
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname SW4
!
no logging console
enable password cisco
!
no aaa new-model
vtp domain CCIE
vtp mode transparent
ip subnet-zero
no ip domain-lookup
!
!

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no file verify auto
spanning-tree mode pvst
spanning-tree extend system-id

vlan internal allocation policy ascending

vlan 300

interface Loopback0
    ip address 120.100.10.1 255.255.255.0

interface FastEthernet0/1

interface FastEthernet0/2

interface FastEthernet0/3

interface FastEthernet0/4

interface FastEthernet0/5

interface FastEthernet0/6

interface FastEthernet0/7


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Lab 1 Router and Switch Configuration Files

interface FastEthernet0/8

interface FastEthernet0/9

interface FastEthernet0/10

interface FastEthernet0/11

interface FastEthernet0/12

interface FastEthernet0/13

interface FastEthernet0/14

interface FastEthernet0/15

interface FastEthernet0/16

interface FastEthernet0/17

interface FastEthernet0/18

interface FastEthernet0/19
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/20
  switchport trunk encapsulation dot1q
  switchport mode trunk

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interface FastEthernet0/21
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/22
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/23
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/24
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface GigabitEthernet0/1

interface GigabitEthernet0/2

interface Vlan1
  no ip address
  shutdown

interface Vlan300
  ip address 150.100.3.10 255.255.255.0

  ip classless
  ip http server
Lab 1 Router and Switch Configuration Files

```
ip http secure-server
!
!
control-plane
!
!
line con 0
   exec-timeout 0 0
   password cisco
   logging synchronous
   login
line vty 0 4
   no login
line vty 5 15
   exec-timeout 0 0
   password cisco
   logging synchronous
   login
   transport input telnet
!
end
```

Switch 4 Final Configuration

```
SW4# sh run
Building configuration...

Current configuration : 3400 bytes
!
```
version 12.2
no service pab
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname SW4
!
no logging console
enable password cisco
!
no aaa new-model
vtp domain CCIE
vtp mode transparent
ip subnet-zero
ip routing
no ip domain-lookup
!
ip dhcp snooping vlan 300
ip dhcp snooping
!
!
!
!
errdisable recovery cause link-flap
errdisable recovery interval 35
port-channel load-balance dst-mac
no file verify auto
spanning-tree mode pvst
Lab 1 Router and Switch Configuration Files

```
spanning-tree extend system-idB
!
vlan internal allocation policy ascending
!
vlan 300
!
interface Loopback0
 ip address 120.100.10.1 255.255.255.0
!
interface Port-channel1
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
interface Port-channel2
 switchport trunk encapsulation dot1q
 switchport mode trunk
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
interface FastEthernet0/3
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
```
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
interface FastEthernet0/10
!
interface FastEthernet0/11
   switchport access vlan 300
   switchport mode access
   spanning-tree portfast
   ip verify source
   ip dhcp snooping limit rate 10
!
interface FastEthernet0/12
   switchport access vlan 300
   switchport mode access
   spanning-tree portfast
   ip verify source
   ip dhcp snooping limit rate 10
!
interface FastEthernet0/13
   switchport access vlan 300
   switchport mode access
   spanning-tree portfast
   ip verify source
   ip dhcp snooping limit rate 10
!
Lab 1 Router and Switch Configuration Files

interface FastEthernet0/14
  switchport access vlan 300
  switchport mode access
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10

interface FastEthernet0/15
  switchport access vlan 300
  switchport mode access
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10

interface FastEthernet0/16
  switchport access vlan 300
  switchport mode access
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10

interface FastEthernet0/17
  switchport access vlan 300
  switchport mode access
  spanning-tree portfast
  ip verify source
  ip dhcp snooping limit rate 10

interface FastEthernet0/18

Lab 1 Router and Switch Configuration Files

interface FastEthernet0/19
  switchport trunk encapsulation dot1q
  switchport mode trunk
  channel-group 1 mode on

interface FastEthernet0/20
  switchport trunk encapsulation dot1q
  switchport mode trunk
  channel-group 1 mode on

interface FastEthernet0/21
  switchport trunk encapsulation dot1q
  switchport mode trunk
  channel-group 2 mode on

interface FastEthernet0/22
  switchport trunk encapsulation dot1q
  switchport mode trunk
  channel-group 2 mode on

interface FastEthernet0/23
  switchport trunk encapsulation dot1q
  switchport mode trunk
  shutdown

interface FastEthernet0/24
  switchport trunk encapsulation dot1q
  switchport mode trunk
  shutdown
Lab 1 Router and Switch Configuration Files

interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
  no ip address
  shutdown
!
interface Vlan300
  ip address 150.100.3.10 255.255.255.0
!
router eigrp 1
  network 120.100.10.1 0.0.0.0
  network 150.100.3.10 0.0.0.0
  no auto-summary
!
ip classless
ip http server
ip http secure-server
!
!
control-plane
!
!
line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login

Lab 1 Router and Switch Configuration Files

```
line vty 0 4
    no login
line vty 5 15
    exec-timeout 0 0
    password cisco
    logging synchronous
    login
    transport input telnet

end

SN4# sh version
Cisco IOS Software, C3560 Software (C3560-IPSERVICESK9-M), Version 12.2(25)SEE, RELEASE SOFTWARE (fc2)
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Fri 03-Feb-06 07:38 by antonino
Image text-base: 0x00003000, data-base: 0x011c5030

ROM: Bootstrap program is C3560 boot loader
BOOTLDR: C3560 Boot Loader (C3560-HBOOT-M) Version 12.2(25r)SEA, RELEASE SOFTWARE (fc)

SN4 uptime is 2 hours, 30 minutes
System returned to ROM by power-on
System image file is 'flash:/c3560-ipservicesk9-mz.122-25.SEE.bin'

This product contains cryptographic features and is subject to United States and local country laws governing import, export, transfer an
```
use. Delivery of Cisco cryptographic products does not imply 
third-party authority to import, export, distribute or use encryption. 
Importers, exporters, distributors and users are responsible for 
compliance with U.S. and local country laws. By using this product you 
agree to comply with applicable laws and regulations. If you are unable 
to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at: 

If you require further assistance please contact us by sending email to 
export@cisco.com.

cisco WS-C3560-24PS (PowerPC405) processor (revision N0) with 118784K/12280K bytes of memory. 
Processor board ID CAT0935N2KD
Last reset from power-on
2 Virtual Ethernet interfaces
24 FastEthernet interfaces
2 Gigabit Ethernet interfaces
The password-recovery mechanism is enabled.

512K bytes of flash-simulated non-volatile configuration memory.
Base ethernet MAC Address : 00:15:62:85:AA:00
Motherboard assembly number : 73-9673-06
Power supply part number : 341-0029-04
Motherboard serial number : CAT09350081
Power supply serial number : DTH09318A22
Model revision number : N0
Motherboard revision number : A0
Lab 1 Router and Switch Configuration Files

Model number : WS-C3560-24PS-S
System serial number : CAT0935N2KM
Top Assembly Part Number : 800-25861-03
Top Assembly Revision Number : B0
Version ID : V05
CLEI Code Number : COM1X00ARB
Hardware Board Revision Number : 0x01

<table>
<thead>
<tr>
<th>Switch</th>
<th>Ports</th>
<th>Model</th>
<th>SW Version</th>
<th>SW Image</th>
</tr>
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<tr>
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<td>WS-C3560-24PS</td>
<td>12.2(25)SEE</td>
<td>C3560-IPSERVICESK9-M</td>
</tr>
</tbody>
</table>

Configuration register is 0xF

SW4# sh ip route

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, 0 - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
O - ODR, P - periodic downloaded static route

Gateway of last resort is not set

150.100.0.0/24 is subnetted, 3 subnets

D EX 150.100.2.0 [170/284416] via 150.100.3.6, 01:25:57, Vlan300
C 150.100.3.0 is directly connected, Vlan300
### Lab 1 Router and Switch Configuration Files

<table>
<thead>
<tr>
<th>Device</th>
<th>Address</th>
<th>Subnet Mask</th>
<th>Default Gateway</th>
<th>Interface</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>150.100.1.0</td>
<td>170/284416</td>
<td>150.100.3.6</td>
<td>16:25:57</td>
<td>Vlan300</td>
</tr>
<tr>
<td>D</td>
<td>120.0.0.0/8</td>
<td>variable</td>
<td>16 subnets, 2 masks</td>
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<td></td>
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<tr>
<td>D</td>
<td>120.100.20.0</td>
<td>170/284416</td>
<td>150.100.3.6</td>
<td>16:19:36</td>
<td>Vlan300</td>
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<tr>
<td>D</td>
<td>120.100.30.0</td>
<td>90/130816</td>
<td>150.100.3.8</td>
<td>16:36:35</td>
<td>Vlan300</td>
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<tr>
<td>C</td>
<td>120.100.40.0</td>
<td>directly connected, Loopback</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>D</td>
<td>120.100.50.0</td>
<td>90/130816</td>
<td>150.100.3.5</td>
<td>16:36:34</td>
<td>Vlan300</td>
</tr>
<tr>
<td>D</td>
<td>120.100.60.0</td>
<td>90/130816</td>
<td>150.100.3.6</td>
<td>16:36:34</td>
<td>Vlan300</td>
</tr>
<tr>
<td>D</td>
<td>120.100.70.0</td>
<td>90/130816</td>
<td>150.100.3.7</td>
<td>16:36:36</td>
<td>Vlan300</td>
</tr>
<tr>
<td>D</td>
<td>120.100.80.0</td>
<td>170/284416</td>
<td>150.100.3.6</td>
<td>16:25:58</td>
<td>Vlan300</td>
</tr>
<tr>
<td>D</td>
<td>120.100.90.0</td>
<td>170/284416</td>
<td>150.100.3.6</td>
<td>16:25:58</td>
<td>Vlan300</td>
</tr>
<tr>
<td>D</td>
<td>120.100.100.0</td>
<td>170/284416</td>
<td>150.100.3.6</td>
<td>16:25:59</td>
<td>Vlan300</td>
</tr>
<tr>
<td>D</td>
<td>120.100.110.0</td>
<td>90/130816</td>
<td>150.100.3.5</td>
<td>16:36:35</td>
<td>Vlan300</td>
</tr>
<tr>
<td>D</td>
<td>120.100.120.0</td>
<td>170/284416</td>
<td>150.100.3.6</td>
<td>16:25:59</td>
<td>Vlan300</td>
</tr>
<tr>
<td>D</td>
<td>120.100.123.0</td>
<td>170/284416</td>
<td>150.100.3.6</td>
<td>16:25:59</td>
<td>Vlan300</td>
</tr>
</tbody>
</table>

SW4#
Appendix B
Lab 2 Router and Switch Configuration Files

Router Configuration Files

Router 1 Initial Configuration

R1# sh run
Building configuration...

Current configuration : 1356 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R1
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionem 10
ip cef
|
|
|
no ip domain lookup
|
voice-card 0
no dspfarm
|
Lab 2 Router and Switch Configuration Files

```
!
!
interface Loopback0
 ip address 120.100.1.1 255.255.255.0
!
interface Loopback255
 ip address 200.200.200.200 255.255.255.0
!
interface GigabitEthernet0/0
 no ip address
 shutdown
duplex auto
 speed auto
 media-type rj45
 negotiation auto
!
interface GigabitEthernet0/1
 ip address 120.100.100.1 255.255.255.0
duplex auto
 speed auto
 media-type rj45
 negotiation auto
!
interface Serial0/0/0
 ip address 120.100.123.1 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 120.100.123.3 103 broadcast
 no frame-relay inverse-arp
!
```
interface Serial0/0/1
   no ip address
   shutdown

ip http server
no ip http secure-server

control-plane

line con 0
   exec-timeout 0 0
   password cisco
   logging synchronous
Lab 2 Router and Switch Configuration Files

login
stopbits 1
line aux 0
stopbits 1
line vty 0 4
eexec-timeout 0 0
password cisco
logging synchronous
login
transport input telnet

! scheduler allocate 20000 1000
!
webvpn context Default_context
ssl authenticate verify all
!
no inservice
!
!
end

Router 1 Final Configuration

R1# sh run
Building configuration...

Current configuration : 3282 bytes
!
version 12.4
Lab 2 Router and Switch Configuration Files

```
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R1
!
boot-start-marker
warm-reboot
boot-end-marker
!
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionem 10
ip cef
!
!
!
!
no ip domain lookup
ip multicast-routing
ip multicast heartbeat 225.225.0.1 1 1 10
ip reflexive-list timeout 100
!
ipv6 unicast-routing
voice-card 0
```
no dspfarm

interface Tunnel0
   no ip address
   ipv6 address 2007:C15:C0:11:1::1/64
   ipv6 rip CCIE enable
   tunnel source Serial0/0/0
Lab 2 Router and Switch Configuration Files

tunnel destination 120.100.123.3
  tunnel mode ipv6ip

interface Loopback0
  ip address 120.100.1.1 255.255.255.0
  ip pim sparse-dense-mode

interface Loopback2
  ip address 150.101.1.1 255.255.255.0

interface Loopback255
  ip address 200.200.200.200 255.255.255.0

interface GigabitEthernet0/0
  no ip address
  shutdown
duplex auto
speed auto
media-type rj45
negotiation auto

interface GigabitEthernet0/1
  ip address 120.100.100.1 255.255.255.0
duplex auto
speed auto
media-type rj45
negotiation auto
ipv6 address 2007:C15:C0:10::1/64
ipv6 rip CCIE enable

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Lab 2 Router and Switch Configuration Files

interface Serial0/0/0
  ip address 120.100.123.1 255.255.255.0
  ip access-group FILTER-IN in
  ip access-group FILTER-OUT out
  ip hold-time eigrp 1 200
  ip pim sparse-dense-mode
  encapsulation frame-relay
  ip summary-address eigrp 1 120.100.0.0 255.255.0.0 5 leak-map LEAK-VLAN-100-LOOP0
  frame-relay map ip 120.100.123.2 103 broadcast
  frame-relay map ip 120.100.123.3 103 broadcast
  no frame-relay inverse-arp

interface Serial0/0/1
  no ip address
  shutdown

router eigrp 1
  network 120.100.1.0 0.0.0.255
  network 120.100.100.0 0.0.0.255
  network 120.100.123.0 0.0.0.255
  network 150.101.1.0 0.0.0.255
  no auto-summary

router bgp 100
  bgp router-id 120.100.1.1
  bgp log-neighbor-changes
  neighbor 120.100.3.1 remote-as 100
  neighbor 120.100.3.1 transport connection-mode passive
  neighbor 120.100.3.1 update-source Loopback0

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address-family ipv4
neighbor 120.100.3.1 activate
no auto-summary
no synchronization
exit-address-family

no ip http server
no ip http secure-server
ip pim send-rp-announce Loopback0 scope 3 group-list GROUPS

ip access-list standard GROUPS
  permit 225.225.0.1
  permit 225.225.0.2
  permit 225.225.0.3
  permit 225.225.0.4

ip access-list extended FILTER-IN
  permit icmp any any
  permit eigrp any any
  permit tcp host 120.100.3.1 host 120.100.1.1 eq bgp
  permit pim any any
  permit 41 host 120.100.123.3 host 120.100.123.1
evaluate DYNAMIC-TCP
ip access-list extended FILTER-OUT
  permit tcp any any reflect DYNAMIC-TCP

access-list 1 permit 120.100.1.0
access-list 1 permit 120.100.100.0
Lab 2 Router and Switch Configuration Files

```
snmp-server enable traps ipmulticast
snmp-server host 120.100.100.100 public

ipv6 router rip CCIE

route-map LEAK-VLAN-100-LOOP0 permit 10
  match ip address 1

control-plane

line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  stopbits 1
```
Lab 2 Router and Switch Configuration Files

```
line aux 0
stopbits 1
line vty 0 4
exec-timeout 0 0
password cisco
logging synchronous
login
transport input telnet
!
scheduler allocate 20000 1000
!
webvpn context Default_context
ssl authenticate verify all
!
no inservice
!
!
end
```

```
R1# show ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
     D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
     N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
     E1 - OSPF external type 1, E2 - OSPF external type 2
     i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
     *i - candidate default, U - per-user static route
     O - OSPF, P - periodic downloaded static route

Gateway of last resort is not set
```
Lab 2 Router and Switch Configuration Files

C  200.200.200.0/24 is directly connected, Loopback255
    152.200.0.0/24 is subnetted, 4 subnets
B  152.200.32.0 [200/0] via 120.100.34.4, 00:21:45
B  152.200.33.0 [200/0] via 120.100.34.5, 00:21:45
B  152.200.34.0 [200/0] via 120.100.34.5, 00:21:45
B  152.200.35.0 [200/0] via 120.100.34.5, 00:21:45
    152.100.0.0/24 is subnetted, 1 subnets
B  152.100.100.0 [200/0] via 120.100.3.1, 00:21:45
    150.101.0.0/24 is subnetted, 2 subnets
D EX  150.101.2.0 [170/7280866] via 120.100.123.2, 00:21:46, Serial0/0/0
C  150.101.1.0 is directly connected, Loopback2

120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
D EX  120.100.9.1/32 [170/7292416] via 120.100.123.3, 00:21:46, Serial0/0/0
D EX  120.100.8.1/32 [170/7292416] via 120.100.123.3, 00:21:47, Serial0/0/0
D EX  120.100.10.1/32 [170/7292416] via 120.100.123.3, 00:21:47, Serial0/0/0
D EX  120.100.5.1/32 [170/7292416] via 120.100.123.3, 00:19:43, Serial0/0/0
D  120.100.4.0/24 [90/2300416] via 120.100.123.3, 00:21:47, Serial0/0/0
D  120.100.5.0/24 [90/2300416] via 120.100.123.3, 00:21:47, Serial0/0/0
D EX  120.100.4.1/32 [170/7292416] via 120.100.123.3, 00:19:15, Serial0/0/0
D EX  120.100.7.1/32 [170/7292416] via 120.100.123.3, 00:21:47, Serial0/0/0
D EX  120.100.6.1/32 [170/7292416] via 120.100.123.3, 00:21:47, Serial0/0/0
D  120.100.0.0/16 is a summary, 00:21:47, Null0
C  120.100.1.0/24 is directly connected, Loopback0
D  120.100.2.0/24 [90/2300866] via 120.100.123.2, 00:21:47, Serial0/0/0
D  120.100.3.0/24 [90/2297866] via 120.100.123.3, 00:21:47, Serial0/0/0
D EX  120.100.63.0/24 [170/7292416] via 120.100.123.3, 00:19:16, Serial0/0/0
D EX  120.100.53.0/24 [170/7292416] via 120.100.123.3, 00:21:48, Serial0/0/0
D EX  120.100.46.0/24 [170/7292416] via 120.100.123.3, 00:19:16, Serial0/0/0
D  120.100.34.0/24 [90/2172416] via 120.100.123.3, 00:21:48, Serial0/0/0
C  120.100.123.0/24 is directly connected, Serial0/0/0
Lab 2 Router and Switch Configuration Files

C  120.100.100.0/24 is directly connected, GigabitEthernet0/1
D  120.100.200.0/24 [90/2684416] via 120.100.123.2, 00:21:48, Serial0/0/0

R1# sh ip route eigrp

    150.101.0.0/24 is subnetted, 2 subnets
D EX   150.101.2.0 [170/7289566] via 120.100.123.2, 00:21:58, Serial0/0/0
D    120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
D EX   120.100.9.1/32 [170/7292416] via 120.100.123.3, 00:21:58, Serial0/0/0
D EX   120.100.8.1/32 [170/7292416] via 120.100.123.3, 00:21:58, Serial0/0/0
D EX   120.100.10.1/32 [170/7292416] via 120.100.123.3, 00:21:58, Serial0/0/0
D EX   120.100.5.1/32 [170/7292416] via 120.100.123.3, 00:19:55, Serial0/0/0
D    120.100.4.0/24 [90/2300416] via 120.100.123.3, 00:21:58, Serial0/0/0
D    120.100.5.0/24 [90/2300416] via 120.100.123.3, 00:21:58, Serial0/0/0
D EX   120.100.4.1/32 [170/7292416] via 120.100.123.3, 00:19:27, Serial0/0/0
D EX   120.100.7.1/32 [170/7292416] via 120.100.123.3, 00:21:58, Serial0/0/0
D EX   120.100.6.1/32 [170/7292416] via 120.100.123.3, 00:21:58, Serial0/0/0
D    120.100.0.0/16 is a summary, 00:21:58, Null0
D    120.100.2.0/24 [90/2899856] via 120.100.123.2, 00:21:58, Serial0/0/0
D    120.100.3.0/24 [90/2297856] via 120.100.123.3, 00:21:59, Serial0/0/0
D EX   120.100.63.0/24 [170/7292416] via 120.100.123.3, 00:19:28, Serial0/0/0
D EX   120.100.53.0/24 [170/7292416] via 120.100.123.3, 00:21:59, Serial0/0/0
D EX   120.100.46.0/24 [170/7292416] via 120.100.123.3, 00:19:28, Serial0/0/0
D    120.100.34.0/24 [90/2172416] via 120.100.123.3, 00:21:59, Serial0/0/0
D    120.100.200.0/24 [90/2684416] via 120.100.123.2, 00:21:59, Serial0/0/0

R1# sh ip bgp

BGP table version is 6, local router ID is 120.100.1.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r BIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
Lab 2 Router and Switch Configuration Files

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
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<tbody>
<tr>
<td>*i152.100.100.0/24</td>
<td>120.100.100.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>*i152.200.32.0/24</td>
<td>120.100.34.4</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>200 400 i</td>
</tr>
<tr>
<td>*i152.200.33.0/24</td>
<td>120.100.34.5</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>300 400 i</td>
</tr>
<tr>
<td>*i152.200.34.0/24</td>
<td>120.100.34.5</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>300 400 i</td>
</tr>
<tr>
<td>*i152.200.35.0/24</td>
<td>120.100.34.5</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>300 400 i</td>
</tr>
</tbody>
</table>

R1# show ipv6 route
IPv6 Routing Table - 7 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
U - Per-user Static route
I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
D - EIGRP, EX - EIGRP external

R 2007::/16 [120/2]
  via FE80::7064:7B03, Tunnel0
C 2007:C15:C0:10::/64 [0/0]
  via ::, GigabitEthernet0/1
L 2007:C15:C0:10::1/128 [0/0]
  via ::, GigabitEthernet0/1
C 2007:C15:C0:11::/64 [0/0]
  via ::, Tunnel0
L 2007:C15:C0:11::1/128 [0/0]
  via ::, Tunnel0
L FE80::/10 [0/0]
  via ::, Null0
L FF00::/8 [0/0]
  via ::, Null0

R1# show ver
Cisco IOS Software, 3800 Software (C3825-ADVENTERPRISEK9-M), Version 12.4(6)T,
RELEASE SOFTWARE (fc1)
Lab 2 Router and Switch Configuration Files

Technical Support: http://www.cisco.com/techsupport
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Compiled Thu 23-Feb-06 01:02 by ccai

ROM: System Bootstrap, Version 12.3(11r)T2, RELEASE SOFTWARE (fc1)

R1 uptime is 1 hour, 13 minutes
System returned to ROM by reload at 18:15:38 UTC Mon May 14 2007
System image file is "flash:c3825-adventerprisek9-mz.124-6.T.bin"

This product contains cryptographic features and is subject to United States and local country laws governing import, export, transfer and use. Delivery of Cisco cryptographic products does not imply third-party authority to import, export, distribute or use encryption. Importers, exporters, distributors and users are responsible for compliance with U.S. and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:

If you require further assistance please contact us by sending email to export@cisco.com.

Cisco 3825 (revision 1.0) with 472064K/52224K bytes of memory.
Processor board ID FHK937F0VU
2 Gigabit Ethernet interfaces
2 Serial(sync/async) interfaces
Lab 2 Router and Switch Configuration Files

2 Virtual Private Network (VPN) Modules
DRAM configuration is 64 bits wide with parity enabled.
479K bytes of NVRAM.
62720K bytes of ATA System CompactFlash (Read/Write)

Configuration register is @x2102

Router 2 Initial Configuration
R2# sh run
Building configuration...

Current configuration : 1470 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R2
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionem 15
ip cef
|
|
|
|
|
|
|
| no ip domain lookup
|
|
|
|
|
|
|
|
Lab 2 Router and Switch Configuration Files

interface Loopback0
  ip address 120.100.2.1 255.255.255.0

interface FastEthernet0/0
  no ip address
  shutdown
duplex auto
  speed auto

interface Serial0/0
  ip address 120.100.123.2 255.255.255.0
  encapsulation frame-relay
  frame-relay map ip 120.100.123.3 203 broadcast
  no frame-relay inverse-arp

interface FastEthernet0/1
  ip address 120.100.2.1 255.255.255.0
duplex auto
  speed auto

interface Serial0/1
  no ip address
  shutdown


Lab 2 Router and Switch Configuration Files

ip http server
no ip http secure-server

control-plane

line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  stopbits 1
line aux 0
line vty 0 4
  exec-timeout 0 0
  password cisco
logging synchronous
login
transport input telnet
!
!
webvpn context Default_context
ssl authenticate verify all
!
no inservice
!
!
end

Router 2 Final Configuration

R2# sh run
Building configuration...

Current configuration : 3086 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R2
!
boot-start-marker
boot-end-marker
!
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionem 15
ip cef
!
!
no ip domain lookup
ip multicast-routing
!
ipv6 unicast-routing
!
!
Lab 2 Router and Switch Configuration Files

```
class-map match-all VIDEO
    match dscp af41

policy-map VIDEO-QOS
    class VIDEO
        priority percent 40
        compress header ip rtp
    class class-default
        bandwidth percent 60
        random-detect

interface Tunnel0
    no ip address
    ipv6 address 2007:C15:00:12::2/64
    ipv6 rip CCIE enable
    tunnel source Serial0/0
    tunnel destination 120.100.123.3
    tunnel mode ipv6ip
```
interface Loopback0
  ip address 120.100.2.1 255.255.255.0
  ip pim sparse-dense-mode
!
interface Loopback2
  ip address 150.101.1.1 255.255.255.0
!
interface Loopback3
  ip address 150.101.2.1 255.255.255.0
!
interface FastEthernet0/0
  no ip address
  shutdown
duplex auto
  speed auto
!
interface Serial0/0
  ip address 120.100.123.2 255.255.255.0
  ip hold-time eigrp 1 200
  ip pim sparse-dense-mode
  encapsulation frame-relay
  frame-relay map ip 120.100.123.1 203 broadcast
  frame-relay map ip 120.100.123.3 203 broadcast
  no frame-relay inverse-arp
  max-reserved-bandwidth 100
  service-policy output VIDEO-QOS
!
interface FastEthernet0/1
  ip address 120.100.200.1 255.255.255.0
duplex auto
speed auto
ipv6 address 2007:015:00:13::2/64
ipv6 rip CCIE enable
!
interface Serial0/1
  no ip address
  shutdown
!
router eigrp 1
  offset-list 1 out 100 Serial0/0
  network 120.100.2.0 0.0.0.255
  network 120.100.123.0 0.0.0.255
  network 120.100.200.0 0.0.0.255
  network 150.101.1.0 0.0.0.255
  no auto-summary
!
router rip
  version 2
  network 120.0.0.0
  network 150.101.0.0
  distribute-list 2 out Serial0/0
  no auto-summary
!
router bgp 100
  bgp log-neighbor-changes
  neighbor 120.100.3.1 remote-as 100
  neighbor 120.100.3.1 transport connection-mode passive
  neighbor 120.100.3.1 update-source Loopback0
!
address-family ipv4
neighbor 120.100.3.1 activate
no auto-summary
no synchronization
exit-address-family

ip http server
no ip http secure-server
ip pin send-rp-announce Loopback0 scope 3 group-list GROUPS

ip access-list standard GROUPS
  permit 225.225.0.1
  permit 225.225.0.2
  permit 225.225.0.3
  permit 225.225.0.4

access-list 1 permit 150.101.1.0
access-list 2 permit 150.101.2.0

ipv6 router rip CCIE
control-plane

line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  stopbits 1
line aux 0
line vty 0 4
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  transport input telnet

webvpn context Default_context
  ssl authenticate verify all

Lab 2 Router and Switch Configuration Files

no inservice

R2#
R2# sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
* - candidate default, U -per-user static route
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

152.200.0.0/24 is subnetted, 4 subnets
B   152.200.32.0 [200/0] via 120.100.34.4, 00:21:48
B   152.200.33.0 [200/0] via 120.100.34.5, 00:21:48
B   152.200.34.0 [200/0] via 120.100.34.5, 00:21:48
B   152.200.35.0 [200/0] via 120.100.34.5, 00:21:48

152.100.0.0/24 is subnetted, 1 subnets
B   152.100.100.0 [200/0] via 120.100.3.1, 00:21:48

150.101.0.0/24 is subnetted, 2 subnets
C   150.101.2.0 is directly connected, Loopback3
C   150.101.1.0 is directly connected, Loopback2

120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
D   EX 120.100.8.1/32 [170/7292416] via 120.100.123.3, 00:21:49, Serial0/0
D   EX 120.100.9.1/32 [170/7292416] via 120.100.123.3, 00:21:49, Serial0/0
Lab 2 Router and Switch Configuration Files

D EX 120.100.10.1/32 [170/7292416] via 120.100.123.3, 00:21:49, Serial0/0
D EX 120.100.5.1/32 [170/7292416] via 120.100.123.3, 00:20:45, Serial0/0
D 120.100.4.0/24 [90/2300416] via 120.100.123.3, 00:21:49, Serial0/0
D 120.100.5.0/24 [90/2300416] via 120.100.123.3, 00:21:49, Serial0/0
D EX 120.100.4.1/32 [170/7292416] via 120.100.123.3, 00:20:17, Serial0/0
D EX 120.100.7.1/32 [170/7292416] via 120.100.123.3, 00:21:49, Serial0/0
D EX 120.100.6.1/32 [170/7292416] via 120.100.123.3, 00:21:49, Serial0/0
D 120.100.0.0/16 [90/2684416] via 120.100.123.1, 00:21:49, Serial0/0
D 120.100.1.0/24 [90/2800856] via 120.100.123.1, 00:21:49, Serial0/0
C 120.100.2.0/24 is directly connected, Loopback0
D 120.100.3.0/24 [90/2207856] via 120.100.123.3, 00:21:50, Serial0/0
D EX 120.100.63.0/24 [170/7292416] via 120.100.123.3, 00:20:18, Serial0/0
D EX 120.100.53.0/24 [170/7292416] via 120.100.123.3, 00:21:50, Serial0/0
D EX 120.100.46.0/24 [170/7292416] via 120.100.123.3, 00:20:18, Serial0/0
D 120.100.34.0/24 [90/2172416] via 120.100.123.3, 00:21:50, Serial0/0
C 120.100.123.0/24 is directly connected, Serial0/0
D 120.100.100.0/24 [90/2684416] via 120.100.123.1, 00:21:50, Serial0/0
C 120.100.100.240.0/24 is directly connected, FastEthernet0/1

R2# show ip route eigrp
120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
D EX 120.100.9.1/32 [170/7292416] via 120.100.123.3, 00:21:56, Serial0/0
D EX 120.100.8.1/32 [170/7292416] via 120.100.123.3, 00:21:56, Serial0/0
D EX 120.100.10.1/32 [170/7292416] via 120.100.123.3, 00:21:56, Serial0/0
D EX 120.100.5.1/32 [170/7292416] via 120.100.123.3, 00:20:51, Serial0/0
D 120.100.4.0/24 [90/2300416] via 120.100.123.3, 00:21:56, Serial0/0
D 120.100.5.0/24 [90/2300416] via 120.100.123.3, 00:21:56, Serial0/0
D EX 120.100.4.1/32 [170/7292416] via 120.100.123.3, 00:20:23, Serial0/0
D EX 120.100.7.1/32 [170/7292416] via 120.100.123.3, 00:21:56, Serial0/0
D EX 120.100.6.1/32 [170/7292416] via 120.100.123.3, 00:21:56, Serial0/0
D 120.100.0.0/16 [90/2684416] via 120.100.123.1, 00:21:56, Serial0/0

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Lab 2 Router and Switch Configuration Files

D  120.100.1.0/24 [90/280856] via 120.100.123.1, 00:21:55, Serial0/0
D  120.100.3.0/24 [90/229758] via 120.100.123.3, 00:21:56, Serial0/0
D EX 120.100.63.0/24 [170/7292416] via 120.100.123.3, 00:20:24, Serial0/0
D EX 120.100.65.0/24 [170/7292416] via 120.100.123.3, 00:20:24, Serial0/0
D  120.100.46.0/24 [170/7292416] via 120.100.123.3, 00:20:24, Serial0/0
D  120.100.34.0/24 [90/2172416] via 120.100.123.3, 00:21:57, Serial0/0
D  120.100.100.0/24 [90/2684416] via 120.100.123.3, 00:21:57, Serial0/0

R2# sh ip bgp
BGP table version is 6, local router ID is 150.101.2.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*152.100.100.0/24</td>
<td>120.100.3.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>i</td>
</tr>
<tr>
<td>*152.200.32.0/24</td>
<td>120.100.34.4</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>200 400 i</td>
</tr>
<tr>
<td>*152.200.33.0/24</td>
<td>120.100.34.5</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>300 400 i</td>
</tr>
<tr>
<td>*152.200.34.0/24</td>
<td>120.100.34.5</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>300 400 i</td>
</tr>
<tr>
<td>*152.200.35.0/24</td>
<td>120.100.34.5</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>300 400 i</td>
</tr>
</tbody>
</table>

R2# sh ipv6 route
IPv6 Routing Table - 7 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
U - Per-user Static route
I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
D - EIGRP, EX - EIGRP external
R  2007::/16 [120/2]
    via FE80::7664:7B03, Tunnel0

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Lab 2 Router and Switch Configuration Files

C 2007:C15:C0:12::/64 [0/0]
   via ::, Tunnel0
L 2007:C15:C0:12::2/128 [0/0]
   via ::, Tunnel0
C 2007:C15:C0:13::/64 [0/0]
   via ::, FastEthernet0/1
L 2007:C15:C0:13::2/128 [0/0]
   via ::, FastEthernet0/1
L FE80::/10 [0/0]
   via ::, Null0
L FF00::8 [0/0]
   via ::, Null0

R2#
R2# sh ver
Cisco IOS Software, 3700 Software (C3725-ADVENTERPRISEK9-M), Version 12.4(6)T,
RELEASE SOFTWARE (fc1)
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Compiled Thu 23-Feb-06 00:26 by ccai

ROM: System Bootstrap, Version 12.2(8r)T2, RELEASE SOFTWARE (fc1)

R2 uptime is 1 hour, 15 minutes
System returned to ROM by reload
System image file is "flash:c3725-adventerprisek9-mz.124-6.T.bin"

This product contains cryptographic features and is subject to Unites...
States and local country laws governing import, export, transfer anB
use. Delivery of Cisco cryptographic products does not imply
Lab 2 Router and Switch Configuration Files

third-party authority to import, export, distribute or use encryption. Importers, exporters, distributors and users are responsible for compliance with U.S. and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at: http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to export@cisco.com.

Cisco 3725 (R7000) processor (revision 0.1) with 223232K/38912K bytes of memory.
Processor board ID JMX016L02F
R7000 CPU at 240MHz, Implementation 39, Rev 3.3, 256KB L2 Cache
2 FastEthernet interfaces
2 Serial(sync/async) interfaces
DRAM configuration is 64 bits wide with parity disabled.
55K bytes of NVRAM.
125184K bytes of ATA System CompactFlash (Read/Write)

Configuration register is 0x2102

Router 3 Initial Configuration

R3# sh run
Building configuration...

Current configuration : 1523 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R3
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionem 15
ip cef
!
!
!
no ip domain lookup
!
voice-card 0
no dspfarm
!
!

interface Loopback0
  ip address 120.100.3.1 255.255.255.0

interface Loopback255
  ip address 200.200.200.200 255.255.255.0

interface GigabitEthernet0/0
  ip address 120.100.34.3 255.255.255.0
  duplex auto
  speed auto

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Lab 2 Router and Switch Configuration Files

media-type rj45
negotation auto

! interface GigabitEthernet0/1
   no ip address
   shutdown
duplex auto
speed auto
media-type rj45
negotation auto

! interface Serial0/0/0
   ip address 120.100.123.3 255.255.255.0
   encapsulation frame-relay
   frame-relay map ip 120.100.123.1 301 broadcast
   frame-relay map ip 120.100.123.2 302 broadcast
   no frame-relay inverse-arp

! interface Serial0/0/1
   no ip address
   shutdown

! !

ip http server
no ip http secure-server

! !
Lab 2 Router and Switch Configuration Files

```
!
!
!
control-plane
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
line con 0
    exec-timeout 0 0
    password cisco
    logging synchronous
    login
    stopbits 1
line aux 0
    stopbits 1
line vty 0 4
    exec-timeout 0 0
    password cisco
    logging synchronous
    login
    transport input telnet
!
scheduler allocate 20000 1000
!
```

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Lab 2 Router and Switch Configuration Files

webvpn context Default_context
  ssl authenticate verify all
  !
  no inservice
  !
  !
end

Router 3 Final Configuration

R3# sh run
Building configuration...

Current configuration : 4237 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R3
!
boot-start-marker
boot-end-marker
!
enable password cisco
!
no aaa new-model
!
resource policy

memory-size ionem 15
ip cef

no ip domain lookup
ip multicast-routing
ipv6 unicast-routing
voice-card 0
no dspfarm
interface Tunnel0
   no ip address
   ipv6 address 2007:C15:C0:11::3/64
   ipv6 rip CCIE enable
   ipv6 rip CCIE summary-address 2007::/16
   tunnel source Serial0/0/0
   tunnel destination 120.100.123.1
   tunnel mode ipv6ip
!
interface Tunnel1
   no ip address
   ipv6 address 2007:C15:C0:12::3/64
   ipv6 rip CCIE enable
   ipv6 rip CCIE summary-address 2007::/16
   tunnel source Serial0/0/0
   tunnel destination 120.100.123.2
   tunnel mode ipv6ip
!
interface Loopback0
   ip address 120.100.3.1 255.255.255.0
   ip pim sparse-dense-mode
!
Lab 2 Router and Switch Configuration Files

```plaintext
interface Loopback5
  ip address 152.100.100.1 255.255.255.0

interface Loopback255
  ip address 200.200.200.200 255.255.255.0

interface GigabitEthernet0/0
  ip address 120.100.34.3 255.255.255.0
  ip pim sparse-dense-mode
duplex auto
speed auto
media-type rj45
negotiation auto
ipv6 address 2007:0c15:00:14::3/64
ipv6 ospf 1 area 0

interface GigabitEthernet0/1
  no ip address
  shutdown
duplex auto
speed auto
media-type rj45
negotiation auto

interface Serial0/0/0
  ip address 120.100.123.3 255.255.255.0
  ip hold-time eigrp 1 200
  no ip next-hop-self eigrp 1
  ip pim sparse-dense-mode
  encapsulation frame-relay
```
no ip split-horizon eigrp 1
frame-relay map ip 120.100.123.1 301 broadcast
frame-relay map ip 120.100.123.2 302 broadcast
no frame-relay inverse-arp

! interface Serial0/0/1
  no ip address
  shutdown

! router eigrp 1
  redistribute rip
  network 120.100.3.0 0.0.0.255
  network 120.100.34.0 0.0.0.255
  network 120.100.123.0 0.0.0.255
default-metric 1544 20000 255 1 1500
distribute-list route-map PENALISE-VLAN63 in GigabitEthernet0/0
  no auto-summary
  eigrp router-id 120.100.3.1

! router rip
  version 2
  passive-interface Serial0/0/0
  network 120.0.0.0
  no auto-summary

! router bgp 100
  bgp log-neighbor-changes
  neighbor AS100 peer-group
  neighbor AS100 remote-as 100
  neighbor AS100 transport connection-mode active
neighbor AS100 update-source Loopback0
neighbor 120.100.1.1 peer-group AS100
neighbor 120.100.2.1 peer-group AS100
neighbor 120.100.34.4 remote-as 200
neighbor 120.100.34.5 remote-as 300
!
address-family ipv4
neighbor AS100 route-reflector-client
neighbor 120.100.1.1 activate
neighbor 120.100.2.1 activate
neighbor 120.100.34.4 activate
neighbor 120.100.34.4 capability obs prefix-list send
neighbor 120.100.34.4 prefix-list FILTER in
neighbor 120.100.34.5 activate
no auto-summary
no synchronization
network 152.100.100.0 mask 255.255.255.0
exit-address-family
!
!
!
no ip http server
no ip http secure-server
ip pim send-rp-discovery scope 2
ip pim rp-announce-filter rp-list R1 group-list R1-GROUPS
ip pim rp-announce-filter rp-list R2 group-list R2-GROUPS
!
ip access-list standard R1
permit 120.100.1.1
ip access-list standard R1-GROUPS
  permit 225.225.0.1
  permit 225.225.0.2
ip access-list standard R2
  permit 120.100.2.1
ip access-list standard R2-GROUPS
  permit 225.225.0.3
  permit 225.225.0.4
!
!
ip prefix-list FILTER seq 5 deny 152.200.33.0/24
ip prefix-list FILTER seq 10 deny 152.200.34.0/24
ip prefix-list FILTER seq 15 deny 152.200.35.0/24
ip prefix-list FILTER seq 20 permit 0.0.0.0/0 le 32
access-list 1 permit 120.100.34.4
access-list 2 permit 120.100.63.0
!
!
ipv6 router ospf 1
  log-adjacency-changes
  redistribute rip CCIE metric 5000 include-connecteB
!
ipv6 router rip CCIE
!
!
route-map PENALISE-VLAN63 permit 10
  match ip address 2
  match ip route-source 1
  set metric +500000
!
route-map PENALISE-VLAN63 permit 20

control-plane

line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  transport input telnet
Lab 2 Router and Switch Configuration Files

```
scheduler allocate 20000 1000  
!
webvpn context Default_context  
ssl authenticate verify all  
!
noinservice  
!  
end

R3# sh ip route
Codes: C - connected, S - static, R - RIP, W - mobile, B - BGP  
          D - EIGRP, EX - EIGRP external, 0 - OSPF, IA - OSPF inter area  
          N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
          E1 - OSPF external type 1, E2 - OSPF external type 2  
          i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
          ia - IS-IS inter area, * - candidate default, U - per-user static route  
          o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

C  200.200.200.0/24 is directly connected, Loopback255  
152.200.0.0/24 is subnetted, 4 subnets
B  152.200.32.0 [20/0] via 120.100.34.4, 00:22:19
B  152.200.33.0 [20/0] via 120.100.34.5, 00:22:19
B  152.200.34.0 [20/0] via 120.100.34.5, 00:22:19
B  152.200.35.0 [20/0] via 120.100.34.5, 00:22:19
152.100.0.0/24 is subnetted, 1 subnets
C  152.100.100.0 is directly connected, Loopback5  
150.101.0.0/24 is subnetted, 2 subnets
```
Lab 2 Router and Switch Configuration Files

R  150.101.2.0 [120/1] via 120.100.123.2, 00:00:19, Serial0/0/0
D  150.101.1.0 [90/2297856] via 120.100.123.1, 00:22:20, Serial0/0/0
    120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
D EX 120.100.9.1/32
    [170/6780416] via 120.100.34.5, 00:21:10, GigabitEthernet0/0
    [170/6780416] via 120.100.34.4, 00:21:10, GigabitEthernet0/0
D EX 120.100.8.1/32
    [170/6780416] via 120.100.34.5, 00:21:10, GigabitEthernet0/0
    [170/6780416] via 120.100.34.4, 00:21:10, GigabitEthernet0/0
D EX 120.100.10.1/32
    [170/6780416] via 120.100.34.5, 00:21:10, GigabitEthernet0/0
    [170/6780416] via 120.100.34.4, 00:21:10, GigabitEthernet0/0
D EX 120.100.5.1/32
    [170/6780416] via 120.100.34.4, 00:21:37, GigabitEthernet0/0
D  120.100.4.0/24
    [90/156160] via 120.100.34.4, 00:22:20, GigabitEthernet0/0
D  120.100.5.0/24
    [90/156160] via 120.100.34.5, 00:22:20, GigabitEthernet0/0
D EX 120.100.4.1/32
    [170/6780416] via 120.100.34.5, 00:21:10, GigabitEthernet0/0
D EX 120.100.7.1/32
    [170/6780416] via 120.100.34.5, 00:21:10, GigabitEthernet0/0
    [170/6780416] via 120.100.34.4, 00:21:10, GigabitEthernet0/0
D EX 120.100.6.1/32
    [170/6780416] via 120.100.34.5, 00:21:10, GigabitEthernet0/0
    [170/6780416] via 120.100.34.4, 00:21:10, GigabitEthernet0/0
D  120.100.0.0/16 [90/2172416] via 120.100.123.1, 00:22:21, Serial0/0/0
D  120.100.1.0/24 [90/2297856] via 120.100.123.1, 00:22:21, Serial0/0/0
D  120.100.2.0/24 [90/2297856] via 120.100.123.2, 00:22:21, Serial0/0/0
C  120.100.3.0/24 is directly connected, Loopback0

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Lab 2 Router and Switch Configuration Files

```
D EX 120.100.63.0/24
    [170/6780416] via 120.100.34.5, 00:21:10, GigabitEthernet0/0

D EX 120.100.53.0/24
    [170/6780416] via 120.100.34.5, 00:21:38, GigabitEthernet0/0
    [170/6780416] via 120.100.34.4, 00:21:39, GigabitEthernet0/0

D EX 120.100.46.0/24
    [170/6780416] via 120.100.34.5, 00:21:11, GigabitEthernet0/0

C 120.100.34.0/24 is directly connected, GigabitEthernet0/0

C 120.100.123.0/24 is directly connected, Serial0/0/0

D 120.100.100.0/24 [90/2172416] via 120.100.123.1, 00:22:22, Serial0/0/0

D 120.100.200.0/24 [90/2172416] via 120.100.123.2, 00:22:22, Serial0/0/0

R3#
R3# sh ip route eigrp
  150.101.0.0/24 is subnetted, 2 subnets
  D 150.101.1.0 [90/2297856] via 120.100.123.1, 00:22:28, Serial0/0/0
    120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks

D EX 120.100.9.1/32
    [170/6780416] via 120.100.34.5, 00:21:17, GigabitEthernet0/0
    [170/6780416] via 120.100.34.4, 00:21:17, GigabitEthernet0/0

D EX 120.100.8.1/32
    [170/6780416] via 120.100.34.5, 00:21:17, GigabitEthernet0/0
    [170/6780416] via 120.100.34.4, 00:21:17, GigabitEthernet0/0

D EX 120.100.10.1/32
    [170/6780416] via 120.100.34.5, 00:21:17, GigabitEthernet0/0
    [170/6780416] via 120.100.34.4, 00:21:17, GigabitEthernet0/0

D EX 120.100.5.1/32
    [170/6780416] via 120.100.34.4, 00:21:45, GigabitEthernet0/0

D 120.100.4.0/24
    [90/156160] via 120.100.34.4, 00:22:28, GigabitEthernet0/0
```
Lab 2 Router and Switch Configuration Files

D  120.100.5.0/24
   [90/156160] via 120.100.34.5, 00:22:28, GigabitEthernet0/0

D  120.100.4.1/32
   [170/6780416] via 120.100.34.5, 00:21:18, GigabitEthernet0/0

D  120.100.7.1/32
   [170/6780416] via 120.100.34.5, 00:21:18, GigabitEthernet0/0
   [170/6780416] via 120.100.34.4, 00:21:18, GigabitEthernet0/0

D  120.100.6.1/32
   [170/6780416] via 120.100.34.5, 00:21:19, GigabitEthernet0/0
   [170/6780416] via 120.100.34.4, 00:21:19, GigabitEthernet0/0

D  120.100.0.0/16 [90/2172416] via 120.100.123.1, 00:22:30, Serial0/0/0

D  120.100.1.0/24 [90/2297856] via 120.100.123.1, 00:22:30, Serial0/0/0

D  120.100.2.0/24 [90/2297856] via 120.100.123.2, 00:22:30, Serial0/0/0

D  120.100.63.0/24
   [170/6780416] via 120.100.34.5, 00:21:19, GigabitEthernet0/0

D  120.100.53.0/24
   [170/6780416] via 120.100.34.5, 00:21:47, GigabitEthernet0/0
   [170/6780416] via 120.100.34.4, 00:21:47, GigabitEthernet0/0

D  120.100.46.0/24
   [170/6780416] via 120.100.34.5, 00:21:19, GigabitEthernet0/0

D  120.100.100.0/24 [90/2172416] via 120.100.123.1, 00:22:30, Serial0/0/0

D  120.100.200.0/24 [90/2172416] via 120.100.123.2, 00:22:30, Serial0/0/0

R0# sh ip bgp
BGP table version is 6, local router ID is 200.200.200.200
Status codes:  s suppressed,  d damped,  h history,  * valid,  > best,  i - internal,
               r RIB-failure,  S Stale
Origin codes:  i - IGP,  e - EGP,  ? - incomplete

+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+-----------------+
<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*&gt; 152.100.100.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td>32768</td>
<td>i</td>
<td></td>
</tr>
</tbody>
</table>

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Lab 2 Router and Switch Configuration Files

* 152.200.32.0/24 120.100.34.5 0 300 300 300 400 i
*> 120.100.34.4 0 200 400 i
*> 152.200.33.0/24 120.100.34.5 0 300 400 i
*> 152.200.34.0/24 120.100.34.5 0 300 400 i
*> 152.200.35.0/24 120.100.34.5 0 300 400 i

R3# sh ipv6 route

IPv6 Routing Table - 11 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
U - Per-user Static route
I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
D - EIGRP, EX - EIGRP external

R 2007:C15:C0:10::/64 [120/2]
via FE80::7864:7B01, Tunnel0

C 2007:C15:C0:11::/64 [0/0]
via ::, Tunnel0

L 2007:C15:C0:11::3/128 [0/0]
via ::, Tunnel0

C 2007:C15:C0:12::/64 [0/0]
via ::, Tunnel1

L 2007:C15:C0:12::3/128 [0/0]
via ::, Tunnel1

R 2007:C15:C0:13::/64 [120/2]
via FE80::7864:7B02, Tunnel1

C 2007:C15:C0:14::/64 [0/0]
via ::, GigabitEthernet0/0

L 2007:C15:C0:14::3/128 [0/0]
via ::, GigabitEthernet0/0

OI 2007:C15:C0:15::/64 [110/2]
via FE80::213:C3FF:FE7B:E4A0, GigabitEthernet0/0

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Lab 2 Router and Switch Configuration Files

L  FE80::/10 [0/0]
  via ::, Null0
L  FF00::/8 [0/0]
  via ::, Null0

R3#
R3# sh ver
Cisco IOS Software, 3800 Software (C3825-ADVENTERPRISEK9-M), Version 12.4(6)T,
RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Thu 23-Feb-06 01:02 by ccai

ROM: System Bootstrap, Version 12.3(11r)T2, RELEASE SOFTWARE (fc1)

R3 uptime is 1 hour, 15 minutes
System returned to ROM by reload at 18:00:26 UTC Mon May 14 2007
System image file is 'flash:c3825-adventureprisek9-mz.124-6.T.bin'

This product contains cryptographic features and is subject to UniteB States and local country laws governing import, export, transfer anB use. Delivery of Cisco cryptographic products does not imply third-party authority to import, export, distribute or use encryption. Importers, exporters, distributors and users are responsible for compliance with U.S. and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return this product immediately.
A summary of U.S. laws governing Cisco cryptographic products may be found at:

If you require further assistance please contact us by sending email to export@cisco.com.

Cisco 3825 (revision 1.0) with 446464K/77824K bytes of memory.
Processor board ID FHK0937F050
2 Gigabit Ethernet interfaces
2 Serial(sync/async) interfaces
2 Virtual Private Network (VPN) Modules
DRAM configuration is 64 bits wide with parity enabled.
479K bytes of NVRAM.
62720K bytes of ATA System CompactFlash (Read/Write)

Configuration register is 0x2102

**Router 4 Initial Configuration**

```bash
R4# sh run
Building configuration...

Current configuration : 1373 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
```
hostname R4
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
ip cef
!
!
!
no ip domain lookup
!
voice-card 0
  no dspfarm
!
!
interface Loopback0
    ip address 120.100.4.4 255.255.255.0

interface GigabitEthernet0/0
    ip address 120.100.34.4 255.255.255.0
    duplex auto
    speed auto
    media-type rj45
    negotiation auto

interface GigabitEthernet0/1
    ip address 120.100.46.4 255.255.255.0
    duplex auto
    speed auto
    media-type rj45
    negotiation auto
interface Serial0/0/0
  no ip address
  shutdown

interface Serial0/0/1
  no ip address
  shutdown

ip http server
no ip http secure-server

control-plane
Lab 2 Router and Switch Configuration Files

```
line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  transport input telnet
!
scheduler allocate 20000 1000
!
webvpn context Default_context
  ssl authenticate verify all
!
  no inservice
!
end
```
Router 4 Final Configuration

R4# show run
Building configuration...

Current configuration : 2278 bytes
!
version 12.4
service timestamps debug datime msec
service timestamps log datime msec
no service password-encryption
!
hostname R4
!
boot-start-marker
boot-end-marker
!
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionmem 10
ip cef
!
!
no ip domain lookup
ip multicast-routing
ipv6 unicast-routing
voice-card 0
no dspfarm
Lab 2 Router and Switch Configuration Files

interface Loopback0
  ip address 120.100.4.1 255.255.255.0
  ip ospf 1 area 0
!
interface GigabitEthernet0/0
  ip address 120.100.34.4 255.255.255.0
  ip pim sparse-dense-mode
duplex auto
  speed auto
  media-type rj45
  negotiation auto
  ipv6 address 2007:c0f:0:14::4/64
  ipv6 ospf 1 area 0
!
interface GigabitEthernet0/1
  ip address 120.100.46.4 255.255.255.0
  ip ospf 1 area 1
duplex auto
  speed auto
  media-type rj45
  negotiation auto
  ipv6 address 2007:c0f:0:15::4/64
  ipv6 ospf 1 area 1
!
interface Serial0/0/0
  no ip address
  shutdown
Lab 2 Router and Switch Configuration Files

interface Serial0/0/1
    no ip address
    shutdown
!
router eigrp 1
   redistribute ospf 1
   network 120.100.4.0 0.0.0.255
   network 120.100.34.0 0.0.0.255
   default-metric 1544 20000 255 1 1500
   no auto-summary
!
router ospf 1
   log-adjacency-changes
   area 1 virtual-link 120.100.6.1
   redistribute eigrp 1 subnets
   default-metric 5000
!
router bgp 200
   no synchronization
   bgp log-neighbor-changes
   neighbor AS200 peer-group
   neighbor AS200 remote-as 200
   neighbor AS200 update-source Loopback0
   neighbor AS200 route-reflector-client
   neighbor 120.100.6.1 peer-group AS200
   neighbor 120.100.8.1 peer-group AS200
   neighbor 120.100.34.3 remote-as 100
   neighbor 120.100.34.3 capability orf prefix-list receive
no auto-summary

no ip http server
no ip http secure-server

ipv6 router ospf 1
  log-adjacency-changes
  area 0 range 2007::/16
  area 1 authentication ipsec spi 500 md5 DEC0DECC1E0DDBA11B0BBBEDDB0B00

control-plane
Lab 2 Router and Switch Configuration Files

```
line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  transport input telnet
!
scheduler allocate 20000 1000
!
webvpn context Default_context
  ssl authenticate verify all
!
  no inservice
!
end
```

R4# sh ip route

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
  D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
  N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
  E1 - OSPF external type 1, E2 - OSPF external type 2
Lab 2 Router and Switch Configuration Files

i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

152.200.0.0/24 is subnetted, 4 subnets
B 152.200.32.0 [200/0] via 120.100.10.1, 00:30:57
B 152.200.33.0 [200/0] via 120.100.10.1, 00:30:57
B 152.200.34.0 [200/0] via 120.100.10.1, 00:30:57
B 152.200.35.0 [200/0] via 120.100.10.1, 00:30:57
152.100.0.0/24 is subnetted, 1 subnets
B 152.100.100.0 [20/0] via 120.100.34.3, 00:30:57
150.101.0.0/24 is subnetted, 2 subnets
D EX 150.101.2.0
[170/2] via 120.100.34.5, 00:30:54, GigabitEthernet0/0
[170/2] via 120.100.34.3, 00:30:55, GigabitEthernet0/0
D 150.101.1.0
[90/1] via 120.100.34.3, 00:30:59, GigabitEthernet0/0
120.0.0.0/8 is variably subnetted, 19 subnets, 3 masks
0 IA 120.100.9.1/32 [110/3] via 120.100.46.6, 00:30:33, GigabitEthernet0/1
0 120.100.8.1/32 [110/2] via 120.100.46.2, 00:30:33, GigabitEthernet0/1
0 IA 120.100.10.1/32 [110/3] via 120.100.46.6, 00:30:33, GigabitEthernet0/1
0 120.100.5.1/32 [110/4] via 120.100.46.6, 00:30:33, GigabitEthernet0/1
C 120.100.4.0/24 is directly connected, Loopback0
D 120.100.5.0/24
[90/156160] via 120.100.34.5, 00:30:59, GigabitEthernet0/0
0 IA 120.100.7.1/32 [110/4] via 120.100.46.6, 00:30:33, GigabitEthernet0/1
0 120.100.6.1/32 [110/2] via 120.100.46.6, 00:30:33, GigabitEthernet0/1
D 120.100.0.0/16
[90/2174976] via 120.100.34.3, 00:30:59, GigabitEthernet0/0

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Lab 2 Router and Switch Configuration Files

D 120.100.1.0/24
   [90/2300416] via 120.100.34.3, 00:30:59, GigabitEthernet0/0

D 120.100.2.0/24
   [90/2300416] via 120.100.34.3, 00:30:59, GigabitEthernet0/0

D 120.100.3.0/24
   [90/156160] via 120.100.34.3, 00:31:00, GigabitEthernet0/0

O IA 120.100.63.0/24 [110/2] via 120.100.46.6, 00:30:34, GigabitEthernet0/1

O IA 120.100.53.0/24 [110/3] via 120.100.46.6, 00:30:34, GigabitEthernet0/1

C 120.100.46.0/24 is directly connected, GigabitEthernet0/1

C 120.100.34.0/24 is directly connected, GigabitEthernet0/0

D 120.100.123.0/24
   [90/2172416] via 120.100.34.3, 00:31:00, GigabitEthernet0/0

D 120.100.100.0/24
   [90/2174976] via 120.100.34.3, 00:31:00, GigabitEthernet0/0

D 120.100.200.0/24
   [90/2174976] via 120.100.34.3, 00:31:00, GigabitEthernet0/0

R4# sh ip eigrp
% Incomplete command.

R4# sh ip route eigrp
   150.101.0.0/24 is subnetted, 2 subnets

D EX 150.101.2.0
   [170/6780416] via 120.100.34.5, 00:30:20, GigabitEthernet0/0
   [170/6780416] via 120.100.34.3, 00:30:20, GigabitEthernet0/0

D 150.101.1.0
   [90/2300416] via 120.100.34.3, 00:31:14, GigabitEthernet0/0

120.0.0.0/8 is variably subnetted, 19 subnets, 3 masks

D 120.100.5.0/24
   [90/156160] via 120.100.34.5, 00:31:14, GigabitEthernet0/0
Lab 2 Router and Switch Configuration Files

D 120.100.0.0/16
   [90/2174976] via 120.100.34.3, 00:31:14, GigabitEthernet0/0
D 120.100.1.0/24
   [90/2300416] via 120.100.34.3, 00:31:14, GigabitEthernet0/0
D 120.100.2.0/24
   [90/2300416] via 120.100.34.3, 00:31:14, GigabitEthernet0/0
D 120.100.3.0/24
   [90/156160] via 120.100.34.3, 00:31:14, GigabitEthernet0/0
D 120.100.123.0/24
   [90/2172416] via 120.100.34.3, 00:31:14, GigabitEthernet0/0
D 120.100.100.0/24
   [90/2174976] via 120.100.34.3, 00:31:14, GigabitEthernet0/0
D 120.100.200.0/24
   [90/2174976] via 120.100.34.3, 00:31:15, GigabitEthernet0/0

R4# sh ip route ospf
120.0.0.0/8 is variably subnetted, 19 subnets, 3 masks
0 IA 120.100.9.1/32 [110/3] via 120.100.46.6, 00:30:53, GigabitEthernet0/1
0 IA 120.100.8.1/32 [110/2] via 120.100.46.2, 00:30:53, GigabitEthernet0/1
0 IA 120.100.10.1/32 [110/3] via 120.100.46.6, 00:30:53, GigabitEthernet0/1
0 IA 120.100.5.1/32 [110/4] via 120.100.46.6, 00:30:53, GigabitEthernet0/1
0 IA 120.100.7.1/32 [110/4] via 120.100.46.6, 00:30:53, GigabitEthernet0/1
0 IA 120.100.6.1/32 [110/2] via 120.100.46.6, 00:30:53, GigabitEthernet0/1
0 IA 120.100.63.0/24 [110/2] via 120.100.46.6, 00:30:53, GigabitEthernet0/1
0 IA 120.100.53.0/24 [110/3] via 120.100.46.6, 00:30:53, GigabitEthernet0/1

R4# sh ip bgp
BGP table version is 6, local router ID is 120.100.4.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
### Lab 2 Router and Switch Configuration Files

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>152.100.100.0/24</td>
<td>120.100.34.3</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>i</td>
</tr>
<tr>
<td>152.200.32.0/24</td>
<td>120.100.10.1</td>
<td>0</td>
<td>100</td>
<td>400</td>
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<td>152.200.33.0/24</td>
<td>120.100.34.5</td>
<td>0</td>
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<td>300 400 400</td>
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<tr>
<td>152.200.35.0/24</td>
<td>120.100.34.5</td>
<td>0</td>
<td>100</td>
<td>300 400 400</td>
<td>i</td>
</tr>
</tbody>
</table>

```
R4# sh ipv6 route
IPv6 Routing Table - 11 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       U - Per-user Static route
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       OI1 - OSPF NSSA ext 1, OI2 - OSPF NSSA ext 2
       D - EIGRP, EX - EIGRP external

0  2007::/16 [110/0]
   via ::, Null0
0E2 2007:C15:C0:10::/64 [110/5000]
   via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
0E2 2007:C15:C0:11::/64 [110/5000]
   via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
0E2 2007:C15:C0:12::/64 [110/5000]
   via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
0E2 2007:C15:C0:13::/64 [110/5000]
   via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
C  2007:C15:C0:14::/64 [0/0]
   via ::, GigabitEthernet0/0
```
Lab 2 Router and Switch Configuration Files

L 2007:C15:C0:14::4/128 [0/0]
   via ::, GigabitEthernet0/0
C 2007:C15:C0:15::64 [0/0]
   via ::, GigabitEthernet0/1
L 2007:C15:C0:15::4/128 [0/0]
   via ::, GigabitEthernet0/1
L FE80::10 [0/0]
   via ::, Null0
L FF00::/8 [0/0]
   via ::, Null0

R4#
R4# sh ver
Cisco IOS Software, 3800 Software (C3825-ADVENTERPRISEK9-W), Version 12.4(6)T,
RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Thu 23-Feb-06 01:02 by ccia

ROM: System Bootstrap, Version 12.3(11r)T2, RELEASE SOFTWARE (fc1)

R4 uptime is 1 hour, 24 minutes
System returned to ROM by reload at 18:08:55 UTC Mon May 14 2007
System image file is 'flash:c3825-adventerprisek9-mz.124-6.T.bin'

This product contains cryptographic features and is subject to UniteB
States and local country laws governing import, export, transfer anB
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Lab 2 Router and Switch Configuration Files

Importers, exporters, distributors and users are responsible for compliance with U.S. and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at: http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to export@cisco.com.

Cisco 3825 (revision 1.0) with 472064K/52224K bytes of memory.
Processor board ID FHK@37F0XH
2 Gigabit Ethernet interfaces
2 Serial(sync/async) interfaces
2 Virtual Private Network (VPN) Modules
DRAM configuration is 64 bits wide with parity enabled.
479K bytes of NVRAM.
62720K bytes of ATA System CompactFlash (Read/Write)

Configuration register is 0x2102

Router 5 Initial Configuration
 RS# sh run
 Building configuration...

Current configuration : 1448 bytes
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R5
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size 1024
ip cef
!
!
!
no ip domain lookup
!
voice-card 0
no ds pfarm
!
!
interface Loopback0
  ip address 120.100.6.1 255.255.255.0
!
interface GigabitEthernet0/0
  ip address 120.100.34.5 255.255.255.0
duplex auto
  speed auto
  media-type rj45
  negotiation auto
!
```plaintext
interface GigabitEthernet0/1
  ip address 150.100.53.5 255.255.255.0
duplex auto
  speed auto
media-type rj45
negotiation auto

interface Serial0/0/0
  no ip address
  shutdown

interface Serial0/0/1
  no ip address
  shutdown

ip http server
  no ip http secure-server

control-plane
```
Lab 2 Router and Switch Configuration Files

```
line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  transport input telnet
!
scheduler allocate 20000 1000
!
webvpn context Default_context
  ssl authenticate verify all
```
no in-service

Router 5 Final Configuration

RS# sh run
Building configuration...

Current configuration : 2342 bytes

version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption

hostname R5

boot-start-marker
boot-end-marker

enable password cisco

no aaa new-model

resource policy

memory-size ionem 10
ip cef

no ip domain lookup
ipv6 unicast-routing
voice-card 0
no dspfarm
Lab 2 Router and Switch Configuration Files

interface Loopback0
    ip address 120.100.5.1 255.255.255.0
    ip ospf 1 area 0

interface GigabitEthernet0/0
    ip address 120.100.34.5 255.255.255.0
duplex auto
    speed auto
    media-type rj45
    negotiation auto
    ipv6 address 2001:015:00:14::5/64
    ipv6 ospf 1 area 0

interface GigabitEthernet0/1
    ip address 120.100.53.5 255.255.255.0
    ip ospf 1 area 2
duplex auto
    speed auto
    media-type rj45
    negotiation auto

interface Serial0/0/0
    no ip address
    shutdown

interface Serial0/0/1
  no ip address
  shutdown

router eigrp 1
  redistribute ospf 1
  network 120.100.5.0 0.0.0.255
  network 120.100.34.0 0.0.0.255
  default-metric 1544 20000 255 1 1500
  no auto-summary

router ospf 1
  log-adjacency-changes
  area 2 virtual-link 120.100.9.1
  redistribute eigrp 1 subnets
  default-metric 5000

router bgp 300
  no synchronization
  bgp log-neighbor-changes
  neighbor AS300 peer-group
  neighbor AS300 remote-as 300
  neighbor AS300 update-source Loopback0
  neighbor AS300 route-reflector-client
  neighbor 120.100.7.1 peer-group AS300
  neighbor 120.100.9.1 peer-group AS300
  neighbor 120.100.34.3 remote-as 100
  neighbor 120.100.34.3 route-map PREPEND out
no auto-summary

ip http server
no ip http secure-server

access-list 1 permit 152.200.32.0

ipv6 router ospf 1
  log-adjacency-changes

route-map PREPEND permit 10
  match ip address 1
  continue 20
  set as-path prepend 300

route-map PREPEND permit 20
  match ip address 1
  set as-path prepend 300

route-map PREPEND permit 30

Lab 2 Router and Switch Configuration Files

control-plane
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!
!
!
webvpn context Default_context
  ssl authenticate verify all
  !
  no inservice
  !
  end

RS#
RS# sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       O - ODR, P - periodic downloaded static route

Gateway of last resort is not set

   152.200.0.0/24 is subnetted, 4 subnets
     B    152.200.32.0 [200/0] via 120.100.10.1, 00:34:18
     B    152.200.33.0 [200/0] via 120.100.10.1, 00:34:18
     B    152.200.34.0 [200/0] via 120.100.10.1, 00:34:18
     B    152.200.35.0 [200/0] via 120.100.10.1, 00:34:18

   152.100.0.0/24 is subnetted, 1 subnets
     B    152.100.100.0 [20/0] via 120.100.34.3, 00:34:21

   150.101.0.0/24 is subnetted, 2 subnets
     0 E2  150.101.2.0 [110/5000] via 120.100.53.3, 00:31:06; GigabitEthernet0/1
Lab 2 Router and Switch Configuration Files

D  192.168.1.0
   [0/2300416] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
192.168.1.0/24 is variably subnetted, 19 subnets, 3 masks
   192.168.1.1/24 [110/2] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
0 IA 192.168.1.1/24 [110/4] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
0 IA 192.168.1.1/24 [110/3] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
D  192.168.1.0/24
   [0/156160] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
C 192.168.1.0/24 is directly connected, Loopback0
0 192.168.1.0/24 [110/4] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
0 192.168.1.0/24 [110/2] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
0 IA 192.168.1.0/24 [110/3] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
D  192.168.1.0/16
   [0/2174976] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
D  192.168.1.0/24
   [0/2300416] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
D  192.168.1.0/24
   [0/2300416] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
D  192.168.1.0/24
   [0/2300416] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
D  192.168.1.0/16
   [0/156160] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
0 IA 192.168.1.63.0/24 [110/2] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
C 192.168.1.63.0/24 is directly connected, GigabitEthernet0/1
0 IA 192.168.1.63.0/16 [110/3] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
C 192.168.1.63.0/24 is directly connected, GigabitEthernet0/0
D  192.168.1.123.0/24
   [0/2172416] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
D  192.168.1.0/24
   [0/2174976] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
D  192.168.1.0/24
   [0/2174976] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
D  192.168.1.0/24
   [0/2174976] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
D  192.168.1.0/24
   [0/2174976] via 192.168.1.1, 00:35:06, GigabitEthernet0/0
Lab 2 Router and Switch Configuration Files

```
R5# sh ip route eigrp
  150.101.0.0/24 is subnetted, 2 subnets
  D   150.101.1.0
       [90/2300416] via 120.100.34.3, 00:35:17, GigabitEthernet0/0
  120.0.0.0/8 is variably subnetted, 19 subnets, 3 masks
  D   120.100.4.0/24
       [90/156160] via 120.100.34.4, 00:35:41, GigabitEthernet0/0
  D   120.100.0.0/16
       [90/2174976] via 120.100.34.3, 00:35:17, GigabitEthernet0/0
  D   120.100.1.0/24
       [90/2300416] via 120.100.34.3, 00:35:17, GigabitEthernet0/0
  D   120.100.2.0/24
       [90/2300416] via 120.100.34.3, 00:35:14, GigabitEthernet0/0
  D   120.100.3.0/24
       [90/156160] via 120.100.34.3, 00:35:41, GigabitEthernet0/0
  D   120.100.123.0/24
       [90/2172416] via 120.100.34.3, 00:35:41, GigabitEthernet0/0
  D   120.100.100.0/24
       [90/2174976] via 120.100.34.3, 00:35:17, GigabitEthernet0/0
  D   120.100.200.0/24
       [90/2174976] via 120.100.34.3, 00:35:14, GigabitEthernet0/0

R5# sh ip route ospf
  150.101.0.0/24 is subnetted, 2 subnets
  0   E2   150.101.2.0 [110/5000] via 120.100.53.3, 00:31:23, GigabitEthernet0/1
  120.0.0.0/8 is variably subnetted, 19 subnets, 3 masks
  0   120.100.9.1/32 [110/2] via 120.100.53.3, 00:31:23, GigabitEthernet0/1
  0   IA   120.100.8.1/32 [110/4] via 120.100.53.3, 00:31:23, GigabitEthernet0/1
  0   IA   120.100.10.1/32 [110/3] via 120.100.53.3, 00:31:23, GigabitEthernet0/1
  0   120.100.4.1/32 [110/4] via 120.100.53.3, 00:31:23, GigabitEthernet0/1
  0   120.100.7.1/32 [110/2] via 120.100.53.1, 00:31:23, GigabitEthernet0/1
```

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Lab 2 Router and Switch Configuration Files

```
RS# sh ip bgp
BGP table version is 6, local router ID is 120.100.5.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>* 152.100.100.0/24</td>
<td>120.100.34.3</td>
<td>0</td>
<td>100</td>
<td>0</td>
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<td>0</td>
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<td>400 i</td>
</tr>
</tbody>
</table>
```

RS# sh ipv6 route
IPv6 Routing Table - 9 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
    U - Per-user Static route
    I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
    O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
    ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
    D - EIGRP, EX - EIGRP external

OE2 2007:015:00:10:64 [110/5000]
via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
OE2 2007:015:00:11:64 [110/5000]
via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
OE2 2007:015:00:12:64 [110/5000]
via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
Lab 2 Router and Switch Configuration Files

OE2 2007:C15:C0:13::/64 [110/5000]
    via FE80::214:6AFF:FEFC:7390, GigabitEthernet0/0
C 2007:C15:C0:14::/64 [0/0]
    via ::, GigabitEthernet0/0
L 2007:C15:C0:14::5/128 [0/0]
    via ::, GigabitEthernet0/0
01 2007:C15:C0:15::/64 [110/2]
    via FE80::213:C3FF:FE7B:EA40, GigabitEthernet0/0
L FE80::/10 [0/0]
    via ::, Null0
L FF00::/8 [0/0]
    via ::, Null0

RS#
RS# sh ver
Cisco IOS Software, 3800 Software (C3825-ADVENTERPRISEK9-M), Version 12.4(6)T,
RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Thu 23-Feb-06 01:02 by ccai

ROM: System Bootstrap, Version 12.3(11r)T2, RELEASE SOFTWARE (fc1)

RS uptime is 1 hour, 25 minutes
System returned to ROM by reload at 18:17:51 UTC Mon May 14 2007
System image file is "flash:c3825-adventureprisek9-mz.124-6.T.bin"

This product contains cryptographic features and is subject to UniteB
States and local country laws governing import, export, transfer anB
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
importers, exporters, distributors and users are responsible for
compliance with u.s. and local country laws. by using this product you
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to comply with u.s. and local laws, return this product immediately.

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if you require further assistance please contact us by sending email to
export@cisco.com.

cisco 3825 (revision 1.0) with 472064k/52224k bytes of memory.
processor board id fkh037f005s
2 gigabit ethernet interfaces
2 serial(sync/async) interfaces
2 virtual private network (vpn) modules
dram configuration is 64 bits wide with parity enabled.
479k bytes of nvram.
62720k bytes of ata system compactflash (read/write)

configuration register is 0x2102

router 6 initial configuration
r6# sh run
building configuration...

current configuration : 1332 bytes

version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R6
!
boot-start-marker
boot-end-marker
!
no logging console
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionem 10
ip cef
!
!
!
!
no ip domain lookup
!
voice-card 0
no dspparm
!
!
interface Loopback0
    ip address 120.100.6.1 255.255.255.0

interface GigabitEthernet0/0
    ip address 120.100.46.6 255.255.255.0
duplex auto
    speed auto
    media-type rj45
    negotiation auto

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Lab 2 Router and Switch Configuration Files

interface GigabitEthernet0/1
   ip address 150.100.63.6 255.255.255.0
duplex auto
 speed auto
 media-type rj45
 negotiation auto
 |
interface Serial0/0/0
   no ip address
 shutdown
 |
interface Serial0/0/1
   no ip address
 shutdown
 |
 |
 ip http server
 no ip http secure-server
 |
 |
 control-plane
 |
 |
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Lab 2 Router and Switch Configuration Files

```
!
!
!
!
!
!
!

line con 0
   exec-timeout 0 0
   password cisco
   logging synchronous
   login
   stopbits 1
line aux 0
   stopbits 1
line vty 0 4
   exec-timeout 0 0
   password cisco
   logging synchronous
   login
   transport input telnet
!
scheduler allocate 20000 1000
!
webvpn context Default_context
   ssl authenticate verify all
!
   no inservice
!
end
```
Router 6 Final Configuration

R6# sh run
* Jul 10 20:03:24.463: %SYS-5-CONFIG_I: Configured from console by console
R6# sh run
Building configuration...

Current configuration : 2024 bytes
!
version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname R6
!
boot-start-marker
boot-end-marker
!
enable password cisco
!
no aaa new-model
!
resource policy
!
memory-size ionem 10
ip cef
ip tcp intercept list 100
ip tcp intercept watch-timeout 20
ip tcp intercept mode watch

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Lab 2 Router and Switch Configuration Files

```
ip tcp intercept drop-mode random

no ip domain lookup

ipv6 unicast-routing
voice-card 0
  no dspfarm
```

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interface Loopback0
  ip address 120.100.6.1 255.255.255.0
  ip ospf 1 area 1

interface GigabitEthernet0/0
  ip address 120.100.46.6 255.255.255.0
  ip ospf 1 area 1
duplex auto
speed auto
media-type rj45
negotiation auto
ipv6 address 2007:C05:015::6/64
ipv6 ospf 1 area 1

interface GigabitEthernet0/1
  ip address 120.100.63.6 255.255.255.0
  ip ospf 1 area 3
duplex auto
speed auto
media-type rj45
negotiation auto

interface Serial0/0/0
  no ip address
shutdown

interface Serial0/0/1
  no ip address
  shutdown

router ospf 1
  log-adjacency-changes
  area 1 virtual-link 120.100.4.1
  area 3 virtual-link 120.100.9.1

router bgp 200
  no synchronization
  bgp log-neighbor-changes
  neighbor 120.100.4.1 remote-as 200
  neighbor 120.100.4.1 update-source Loopback0
  neighbor 120.100.10.1 remote-as 400
  neighbor 120.100.10.1 disable-connected-check
  neighbor 120.100.10.1 update-source Loopback0
  no auto-summary

ip http server
no ip http secure-server

access-list 100 permit tcp any 120.100.63.0 0.0.0.255

ipv6 router ospf 1
  log-adjacency-changes
area 1 authentication ipsec spi 500 md5 DEC0DECC1E00DBA11B0BBBEBBDEB0B0

control-plane

line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
  stopbits 1
line aux 0
  stopbits 1
line vty 0 4
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
transport input telnet
!
scheduler allocate 20000 1000
!
webvpn context Default_context
  ssl authenticate verify all
  
  no inservice
  
end

R6#
R6# sh ip route

Codes: C - connected, S - static, R - RIP, W - mobile, B - BGP
D - EIGRP, EX - EIGRP external, 0 - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

152.200.0.0/24 is subnetted, 4 subnets
B 152.200.32.0 [20/0] via 120.100.10.1, 00:35:20
B 152.200.33.0 [20/0] via 120.100.10.1, 00:35:20
B 152.200.34.0 [20/0] via 120.100.10.1, 00:35:20
B 152.200.35.0 [20/0] via 120.100.10.1, 00:35:20
152.100.0.0/24 is subnetted, 1 subnets
Lab 2 Router and Switch Configuration Files

B
152.100.100.0 [200/0] via 120.100.34.3, 00:35:22
   150.101.0.0/24 is sub netted, 2 subnets
0 E2 150.101.2.0 [110/5000] via 120.100.46.4, 00:31:38, GigabitEthernet0/0
0 E2 150.101.1.0 [110/5000] via 120.100.46.4, 00:31:37, GigabitEthernet0/0
   120.0.0.0/8 is vari ably sub netted, 20 subnets, 3 masks
0 IA 120.100.9.1/32 [110/2] via 120.100.63.3, 00:31:37, GigabitEthernet0/1
0 120.100.8.1/32 [110/2] via 120.100.46.2, 00:31:37, GigabitEthernet0/0
0 120.100.10.1/32 [110/2] via 120.100.63.4, 00:31:30, GigabitEthernet0/1
0 120.100.5.1/32 [110/3] via 120.100.63.3, 00:31:39, GigabitEthernet0/1
0 E2 120.100.4.0/24
   [110/5000] via 120.100.46.4, 00:31:39, GigabitEthernet0/0
0 E2 120.100.5.0/24
   [110/5000] via 120.100.46.4, 00:31:30, GigabitEthernet0/0
0 120.100.4.1/32 [110/2] via 120.100.46.4, 00:31:39, GigabitEthernet0/0
0 IA 120.100.7.1/32 [110/3] via 120.100.63.3, 00:31:39, GigabitEthernet0/1
C 120.100.6.0/24 is directly connected, Loopback0
0 E2 120.100.0.0/16
   [110/5000] via 120.100.46.4, 00:31:39, GigabitEthernet0/0
0 E2 120.100.1.0/24
   [110/5000] via 120.100.46.4, 00:31:30, GigabitEthernet0/0
0 E2 120.100.2.0/24
   [110/5000] via 120.100.46.4, 00:31:39, GigabitEthernet0/0
0 E2 120.100.3.0/24
   [110/5000] via 120.100.46.4, 00:31:30, GigabitEthernet0/0
C 120.100.63.0/24 is directly connected, GigabitEthernet0/1
0 IA 120.100.53.0/24 [110/2] via 120.100.63.3, 00:31:40, GigabitEthernet0/1
C 120.100.45.0/24 is directly connected, GigabitEthernet0/0
0 E2 120.100.34.0/24
   [110/5000] via 120.100.46.4, 00:31:40, GigabitEthernet0/0
Lab 2 Router and Switch Configuration Files

0 E2 120.100.123.0/24
   [110/5000] via 120.100.46.4, 00:31:40, GigabitEthernet0/0
0 E2 120.100.100.0/24
   [110/5000] via 120.100.46.4, 00:31:41, GigabitEthernet0/0
0 E2 120.100.200.0/24
   [110/5000] via 120.100.46.4, 00:31:41, GigabitEthernet0/0

RS# sh ip route ospf
150.101.0.0/24 is subnetted, 2 subnets
0 E2 150.101.2.0 [110/5000] via 120.100.46.4, 00:31:46, GigabitEthernet0/0
0 E2 150.101.1.0 [110/5000] via 120.100.46.4, 00:31:46, GigabitEthernet0/0
120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
0 IA 120.100.9.1/32 [110/2] via 120.100.63.3, 00:31:46, GigabitEthernet0/1
0 120.100.8.1/32 [110/2] via 120.100.46.2, 00:31:46, GigabitEthernet0/0
0 120.100.10.1/32 [110/2] via 120.100.63.4, 00:31:46, GigabitEthernet0/1
0 120.100.5.1/32 [110/3] via 120.100.63.3, 00:31:46, GigabitEthernet0/1
0 E2 120.100.4.0/24
   [110/5000] via 120.100.46.4, 00:31:46, GigabitEthernet0/0
0 E2 120.100.5.0/24
   [110/5000] via 120.100.46.4, 00:31:46, GigabitEthernet0/0
0 120.100.4.1/32 [110/2] via 120.100.46.4, 00:31:46, GigabitEthernet0/0
0 IA 120.100.7.1/32 [110/3] via 120.100.63.3, 00:31:46, GigabitEthernet0/1
0 E2 120.100.0.0/16
   [110/5000] via 120.100.46.4, 00:31:46, GigabitEthernet0/0
0 E2 120.100.1.0/24
   [110/5000] via 120.100.46.4, 00:31:47, GigabitEthernet0/0
0 E2 120.100.2.0/24
   [110/5000] via 120.100.46.4, 00:31:47, GigabitEthernet0/0
0 E2 120.100.3.0/24
   [110/5000] via 120.100.46.4, 00:31:47, GigabitEthernet0/0
Lab 2 Router and Switch Configuration Files

0 IA 120.100.53.0/24 [110/2] via 120.100.63.3, 00:31:47, GigabitEthernet0/1
0 E2 120.100.34.0/24
   [110/5000] via 120.100.46.4, 00:31:48, GigabitEthernet0/0
0 E2 120.100.123.0/24
   [110/5000] via 120.100.46.4, 00:31:48, GigabitEthernet0/0
0 E2 120.100.100.0/24
   [110/5000] via 120.100.46.4, 00:31:48, GigabitEthernet0/0
0 E2 120.100.200.0/24
   [110/5000] via 120.100.46.4, 00:31:48, GigabitEthernet0/0

R6# sh ip bgp
BGP table version is 6, local router ID is 120.100.6.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
   r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*i 152.100.100.0/24</td>
<td>120.100.34.3</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>100 i</td>
</tr>
<tr>
<td>* 152.200.32.0/24</td>
<td>120.100.10.1</td>
<td>0</td>
<td>0</td>
<td>400</td>
<td>i</td>
</tr>
<tr>
<td>* 152.200.33.0/24</td>
<td>120.100.10.1</td>
<td>0</td>
<td>0</td>
<td>400</td>
<td>i</td>
</tr>
<tr>
<td>* 152.200.34.0/24</td>
<td>120.100.10.1</td>
<td>0</td>
<td>0</td>
<td>400</td>
<td>i</td>
</tr>
<tr>
<td>* 152.200.35.0/24</td>
<td>120.100.10.1</td>
<td>0</td>
<td>0</td>
<td>400</td>
<td>i</td>
</tr>
</tbody>
</table>

R6# sh ipv6 route
IPv6 Routing Table - 9 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
   U - Per-user Static route
   I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
   0 - OSPF intra, 0I - OSPF inter, 0E1 - OSPF ext 1, 0E2 - OSPF ext 2
   ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
   D - EIGRP, EX - EIGRP external

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Lab 2 Router and Switch Configuration Files

0I 2007::/16 [110/2]
  via FE80::213:C3FF:FE7B:E4A1, GigabitEthernet0/0
0E2 2007:C15:00:10::/64 [110/5000]
  via FE80::213:C3FF:FE7B:E4A1, GigabitEthernet0/0
0E2 2007:C15:00:11::/64 [110/5000]
  via FE80::213:C3FF:FE7B:E4A1, GigabitEthernet0/0
0E2 2007:C15:00:12::/64 [110/5000]
  via FE80::213:C3FF:FE7B:E4A1, GigabitEthernet0/0
0E2 2007:C15:00:13::/64 [110/5000]
  via FE80::213:C3FF:FE7B:E4A1, GigabitEthernet0/0
C 2007:C15:00:15::/64 [0/0]
  via ::, GigabitEthernet0/0
L 2007:C15:00:15::/64 [0/0]
  via ::, GigabitEthernet0/0
L FE80::/10 [0/0]
  via ::, Null0
L FF00::/8 [0/0]
  via ::, Null0

R6#
R6# sh ver
Cisco IOS Software, 3800 Software (C3825-ADVENTPRISEK9-M), Version 12.4(6)T,
RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
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Compiled Thu 23-Feb-06 01:02 by ccai

ROM: System Bootstrap, Version 12.3(11r)T2, RELEASE SOFTWARE (fc1)
Lab 2 Router and Switch Configuration Files

RS uptime is 1 hour, 26 minutes
System returned to ROM by reload at 18:09:22 UTC Mon May 14 2007
System image file is "flash:c3825-adventerprisek9-mz.124-6.T.bin"

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A summary of U.S. laws governing Cisco cryptographic products may be found at:

If you require further assistance please contact us by sending email to export@cisco.com.

Cisco 3825 (revision 1.0) with 472064K/52224K bytes of memory.
Processor board ID FHK0937F0RS
2 Gigabit Ethernet interfaces
2 Serial(sync/async) interfaces
2 Virtual Private Network (VPN) Modules
DRAM configuration is 64 bits wide with parity enabled.
479K bytes of NVRAM.
62720K bytes of ATA System CompactFlash (Read/Write)

Configuration register is 0x2102
Switch Configuration Files

Switch 1 Initial Configuration

SW1# sh run
Building configuration...

Current configuration : 2741 bytes

! version 12.2
no service pab
service timestamps debug uptime
service timestamps log uptime
no service password-encryption

! hostname SW1

! no logging console
enable password cisco

! no aaa new-model
ip subnet-zero
no ip domain-lookup

! vtp domain CCIE
vtp mode transparent
!
!
!
!
no file verify auto
spanning-tree mode pvst
spanning-tree extend system-id
!
vlan internal allocation policy ascending
!
vlan 30,34,46,53,63,100,200
!
!
interface Loopback0
  ip address 120.100.7.1 255.255.255.0
!
interface FastEthernet0/1
  switchport mode dynamic desirable
!
interface FastEthernet0/2
  switchport mode dynamic desirable
!
interface FastEthernet0/3
  switchport access vlan 34
  switchport mode access
!
Lab 2 Router and Switch Configuration Files

interface FastEthernet0/4
  switchport access vlan 34
  switchport mode access

interface FastEthernet0/5
  switchport access vlan 34
  switchport mode access

interface FastEthernet0/6
  switchport access vlan 48
  switchport mode access

interface FastEthernet0/7
  switchport mode dynamic desirable

interface FastEthernet0/8
  switchport mode dynamic desirable

interface FastEthernet0/9
  switchport mode dynamic desirable

interface FastEthernet0/10
  switchport mode dynamic desirable

interface FastEthernet0/11
  switchport mode dynamic desirable

interface FastEthernet0/12
  switchport mode dynamic desirable
interface FastEthernet0/13
    switchport mode dynamic desirable

interface FastEthernet0/14
    switchport mode dynamic desirable

interface FastEthernet0/15
    switchport mode dynamic desirable

interface FastEthernet0/16
    switchport mode dynamic desirable

interface FastEthernet0/17
    switchport mode dynamic desirable

interface FastEthernet0/18
    switchport mode dynamic desirable

interface FastEthernet0/19
    switchport trunk encapsulation dot1q
    switchport mode trunk

interface FastEthernet0/20
    switchport trunk encapsulation dot1q
    switchport mode trunk

interface FastEthernet0/21
    switchport trunk encapsulation dot1q
    switchport mode trunk

Lab 2 Router and Switch Configuration Files

interface FastEthernet0/22
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/23
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/24
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface GigabitEthernet0/1
  switchport mode dynamic desirable

interface GigabitEthernet0/2
  switchport mode dynamic desirable

interface Vlan1
  no ip address
  shutdown

interface Vlan53
  ip address 120.100.53.1 255.255.255.0

  ip classless
  ip http server
  ip http secure-server


Lab 2 Router and Switch Configuration Files

```
class-planet
!
!
line con 0
 exec-timeout 0 0
 password cisco
 logging synchronous
 login
line vty 0 4
 no login
line vty 5 15
 exec-timeout 0 0
 password cisco
 logging synchronous
 login
 transport input telnet
!
end
```

Switch 1 Final Configuration

```
SW1# sh run
Building configuration...

Current configuration : 3254 bytes
!
version 12.2
no service pA
 service timestamps debug uptime
```
service timestamps log uptime
no service password-encryption
!
hostname SW1
!
enable password cisco
!
no aaa new-model
ip subnet-zero
ip routing
no ip domain-lookup
!
vtp domain CCIE
vtp mode transparent
!
!
!
!
!
!
no file verify auto
!
spanning-tree mode rapid-pvst
spanning-tree extend system-id
spanning-tree vlan 34,46,53,63,100,200 priority 24576
!
vlan internal allocation policy ascending
vlan dot1q tag native
!
Lab 2 Router and Switch Configuration Files

vlan 30,34,46,53,63,100,200

interface Loopback0
  ip address 120.100.7.1 255.255.255.0

interface FastEthernet0/1
  switchport mode dynamic desirable

interface FastEthernet0/2
  switchport mode dynamic desirable

interface FastEthernet0/3
  switchport access vlan 34
  switchport mode access

interface FastEthernet0/4
  switchport access vlan 34
  switchport mode access

interface FastEthernet0/5
  switchport access vlan 34
  switchport mode access

interface FastEthernet0/6
  switchport access vlan 46
  switchport mode access
interface FastEthernet0/7
  switchport mode dynamic desirable
!
interface FastEthernet0/8
  switchport mode dynamic desirable
!
interface FastEthernet0/9
  switchport mode dynamic desirable
!
interface FastEthernet0/10
  switchport mode dynamic desirable
!
interface FastEthernet0/11
  switchport mode dynamic desirable
!
interface FastEthernet0/12
  switchport mode dynamic desirable
!
interface FastEthernet0/13
  switchport mode dynamic desirable
!
interface FastEthernet0/14
  switchport mode dynamic desirable
!
interface FastEthernet0/15
  switchport mode dynamic desirable
!
interface FastEthernet0/16
  switchport mode dynamic desirable
!
interface FastEthernet0/17
  switchport mode dynamic desirable
!
interface FastEthernet0/18
  switchport access vlan 30
  switchport mode dot1q-tunnel
!
interface FastEthernet0/19
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/20
  switchport trunk encapsulation dot1q
  switchport mode trunk
  shutdown
!
interface FastEthernet0/21
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/22
  switchport trunk encapsulation dot1q
  switchport mode trunk
  shutdown
!
interface FastEthernet0/23
  switchport trunk encapsulation dot1q
  switchport mode trunk
  udld port aggressive
!
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Lab 2 Router and Switch Configuration Files

```
interface FastEthernet0/24
  switchport trunk encapsulation dot1q
  switchport mode trunk
  shutdown

interface GigabitEthernet0/1
  switchport mode dynamic desirable

interface GigabitEthernet0/2
  switchport mode dynamic desirable

interface Vlan1
  no ip address
  shutdown

interface Vlan53
  ip address 120.100.53.1 255.255.255.0
  ip mtu 1500

router ospf 1
  log-adjacency-changes
  network 120.100.7.1 0.0.0.0 area 2
  network 120.100.53.1 0.0.0.0 area 2

router bgp 300
  no synchronization
  bgp log-neighbor-changes
  neighbor 120.100.5.1 remote-as 300
```
Lab 2 Router and Switch Configuration Files

```
neighbor 120.100.5.1 update-source Loopback0
    no auto-summary

ip classless
ip http server
ip http secure-server

!  
!  
!  
control-plane

!  
!
line con 0
    exec-timeout 0 0
    password cisco
    logging synchronous
    login
line vty 0 4
    no login
line vty 5 15
    exec-timeout 0 0
    password cisco
    logging synchronous
    login
    transport input telnet

end
```
SW1# show ip route ospf

150.101.0.0/24 is subnetted, 2 subnets
0 E2  150.101.2.0 [110/5000] via 120.100.53.3, 00:33:28, Vlan53
0 E2  150.101.1.0 [110/5000] via 120.100.53.5, 00:36:21, Vlan53

120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
0  120.100.0.0/16 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 IA  120.100.1.0/32 [110/2] via 120.100.53.3, 00:36:26, Vlan53
0 IA  120.100.2.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 IA  120.100.3.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 IA  120.100.4.0/32 [110/2] via 120.100.53.3, 00:36:26, Vlan53
0 IA  120.100.5.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 E2  120.100.6.0/16 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 E2  120.100.7.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 E2  120.100.8.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 E2  120.100.9.0/16 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 E2  120.100.10.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 E2  120.100.11.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 E2  120.100.12.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 E2  120.100.13.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 E2  120.100.14.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 E2  120.100.15.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 E2  120.100.16.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 E2  120.100.17.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 E2  120.100.18.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 E2  120.100.19.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53
0 E2  120.100.20.0/24 [110/5000] via 120.100.53.3, 00:36:26, Vlan53

SW1# show ip route

Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2

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Lab 2 Router and Switch Configuration Files

ia - IS-IS inter area, * - candidate default, U - per-user static route
o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

152.200.0.0/24 is subnetted, 4 subnets
  B    152.200.32.0 [200/0] via 120.100.10.1, 00:36:19
  B    152.200.33.0 [200/0] via 120.100.10.1, 00:36:19
  B    152.200.34.0 [200/0] via 120.100.10.1, 00:36:19
  B    152.200.35.0 [200/0] via 120.100.10.1, 00:36:19

152.100.0.0/24 is subnetted, 1 subnets
  B    152.100.100.0 [200/0] via 120.100.34.3, 00:36:22

150.101.0.0/24 is subnetted, 2 subnets
  0 E2   150.101.2.0 [110/5000] via 120.100.53.3, 00:33:35, Vlan53
  0 E2   150.101.1.0 [110/5000] via 120.100.53.5, 00:36:28, Vlan53

120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
  0    120.100.9.1/32 [110/2] via 120.100.53.3, 00:36:38, Vlan53
  0 IA   120.100.8.1/32 [110/4] via 120.100.53.3, 00:36:33, Vlan53
  0 IA   120.100.10.1/32 [110/3] via 120.100.53.3, 00:36:39, Vlan53
  0 IA   120.100.5.1/32 [110/2] via 120.100.53.5, 00:36:39, Vlan53
  0 E2   120.100.4.0/24 [110/5000] via 120.100.53.5, 00:33:36, Vlan53
  0 E2   120.100.5.0/24 [110/5000] via 120.100.53.5, 00:33:09, Vlan53
  0 IA   120.100.4.1/32 [110/4] via 120.100.53.3, 00:36:34, Vlan53
  C   120.100.7.0/24 is directly connected, Loopback0
  0 IA   120.100.6.1/32 [110/3] via 120.100.53.3, 00:36:34, Vlan53
  0 E2   120.100.0.0/16 [110/5000] via 120.100.53.5, 00:36:29, Vlan53
  0 E2   120.100.1.0/24 [110/5000] via 120.100.53.5, 00:36:29, Vlan53
  0 E2   120.100.2.0/24 [110/5000] via 120.100.53.5, 00:36:29, Vlan53
  0 E2   120.100.3.0/24 [110/5000] via 120.100.53.5, 00:36:29, Vlan53
  0 IA   120.100.63.0/24 [110/2] via 120.100.53.3, 00:36:30, Vlan53

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Lab 2 Router and Switch Configuration Files

C 120.100.53.0/24 is directly connected, Vlan53
0 IA 120.100.46.0/24 [110/3] via 120.100.53.3, 00:36:34, Vlan53
0 E2 120.100.34.0/24 [110/5000] via 120.100.53.5, 00:36:29, Vlan53
0 E2 120.100.123.0/24 [110/5000] via 120.100.53.5, 00:36:30, Vlan53
0 E2 120.100.100.0/24 [110/5000] via 120.100.53.5, 00:36:30, Vlan53
0 E2 120.100.200.0/24 [110/5000] via 120.100.53.5, 00:36:30, Vlan53

SW1# sh ip bgp
BGP table version is 6, local router ID is 120.100.7.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
               r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>*&gt;i152.100.100.0/24</td>
<td>120.100.34.3</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>100  i</td>
</tr>
<tr>
<td>*&gt;i152.200.32.0/24</td>
<td>120.100.10.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>400  i</td>
</tr>
<tr>
<td>*&gt;i152.200.33.0/24</td>
<td>120.100.10.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>400  i</td>
</tr>
<tr>
<td>*&gt;i152.200.34.0/24</td>
<td>120.100.10.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>400  i</td>
</tr>
<tr>
<td>*&gt;i152.200.35.0/24</td>
<td>120.100.10.1</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>400  i</td>
</tr>
</tbody>
</table>

SW1# sh cdp neighb
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge,
                 S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone

<table>
<thead>
<tr>
<th>Device ID</th>
<th>Local Interface</th>
<th>Holdtime</th>
<th>Capability</th>
<th>Platform</th>
<th>Port</th>
<th>Port ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>backbone-sw1</td>
<td>Fas 0/10</td>
<td>144</td>
<td>S I</td>
<td>WS-C3560-2Fas0/6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW4</td>
<td>Fas 0/21</td>
<td>133</td>
<td>R S I</td>
<td>WS-C3560-2Fas0/21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW2</td>
<td>Fas 0/23</td>
<td>158</td>
<td>R S I</td>
<td>WS-C3560-2Fas0/23</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW3</td>
<td>Fas 0/19</td>
<td>129</td>
<td>R S I</td>
<td>WS-C3560-2Fas0/19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Lab 2 Router and Switch Configuration Files

R3  Fast 0/3     127  R S I  3825  Gig0/0
R6  Fast 0/6     125  R S I  3825  Gig0/0
R4  Fast 0/4     122  R S I  3825  Gig0/0
R5  Fast 0/5     129  R S I  3825  Gig0/0

SW1#
SW1# sh ver
Cisco IOS Software, C3550 Software (C3550-IPSERVICESK9-M), Version 12.2(25)SEE,
RELEAS SOFTWARE (fc2)
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Fri 03-Feb-06 07:24 by antonino
Image text-base: 0x00003000, data-base: 0x00DBF628

ROM: Bootstrap program is C3550 boot loader

SW1 uptime is 1 hour, 31 minutes
System returned to ROM by power-on
System image file is 'flash:/c3550-ipservicesk9-mz.122-25.SEE.bin'

This product contains cryptographic features and is subject to UniteB
States and local country laws governing import, export, transfer anB
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Lab 2 Router and Switch Configuration Files

Importers, exporters, distributors and users are responsible for compliance with U.S. and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at: http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to export@cisco.com.

Cisco WS-C3550-24 (PowerPC) processor (revision P0) with 65528K/8192K bytes of memory.
Processor board ID CAT0911X17K
Last reset from warm-reset
Running Layer2/3 Switching Image

Ethernet-controller 1 has 12 Fast Ethernet/IEEE 802.3 interfaces

Ethernet-controller 2 has 12 Fast Ethernet/IEEE 802.3 interfaces

Ethernet-controller 3 has 1 Gigabit Ethernet/IEEE 802.3 interface

Ethernet-controller 4 has 1 Gigabit Ethernet/IEEE 802.3 interface

24 FastEthernet interfaces
2 Gigabit Ethernet interfaces
Lab 2 Router and Switch Configuration Files

The password-recovery mechanism is enabled.
384K bytes of flash-simulated NVRAM.
Base ethernet MAC Address: 00:13:80:6D:94:00
Motherboard assembly number: 73-5700-12
Power supply part number: 34-0966-04
Motherboard serial number: CAT091111RK
Power supply serial number: DTH09075G5X
Model revision number: P0
Motherboard revision number: A0
Model number: WS-C3560-24-SMI
System serial number: CAT0911X17K
Configuration register is 0x10F

Switch 2 Initial Configuration

SW2# sh run
Building configuration...

Current configuration : 2258 bytes
!
version 12.2
no service pab
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname SW2
!
no logging console
enable password cisco
!
no aaa new-model
vtp domain CCIE
vtp mode transparent
ip subnet-zero
no ip domain-lookup

!
!
!
!
!
!
!

no file verify auto
spanning-tree mode pvst
spanning-tree extend system-id

!
vlan internal allocation policy ascending
!
vlan 30,34,46,53,63,100,200
!
interface Loopback0
  ip address 120.100.8.1 255.255.255.0
!
interface FastEthernet0/1
  switchport access vlan 100
  switchport mode access
interface FastEthernet0/2
  switchport access vlan 200
  switchport mode access

interface FastEthernet0/3

interface FastEthernet0/4
  switchport access vlan 48

interface FastEthernet0/5
  switchport access vlan 53
  switchport mode access

interface FastEthernet0/6
  switchport access vlan 63
  switchport mode access

interface FastEthernet0/7

interface FastEthernet0/8

interface FastEthernet0/9

interface FastEthernet0/10

interface FastEthernet0/11

interface FastEthernet0/12

interface FastEthernet0/13
|
interface FastEthernet0/14
|
interface FastEthernet0/15
|
interface FastEthernet0/16
|
interface FastEthernet0/17
|
interface FastEthernet0/18
|
interface FastEthernet0/19
  switchport trunk encapsulation dot1q
  switchport mode trunk
|
interface FastEthernet0/20
  switchport trunk encapsulation dot1q
  switchport mode trunk
|
interface FastEthernet0/21
  switchport trunk encapsulation dot1q
  switchport mode trunk
|
interface FastEthernet0/22
  switchport trunk encapsulation dot1q
  switchport mode trunk
|
interface FastEthernet0/23
   switchport trunk encapsulation dot1q
   switchport mode trunk
!
interface FastEthernet0/24
   switchport trunk encapsulation dot1q
   switchport mode trunk
!
interface GigabitEthernet0/1
   switchport mode dynamic desirable
!
interface GigabitEthernet0/2
   switchport mode dynamic desirable
!
interface Vlan1
   no ip address
   shutdown
!
interface Vlan46
   ip address 120.100.46.2 255.255.255.0
!
   ip classless
   ip http server
   ip http secure-server
!
!
control-plane
!
!
Lab 2 Router and Switch Configuration Files

```
line con 0
  exec-timeout 0 0
  password cisco
logging synchronous
login
line vty 0 4
no login
line vty 5 15
  exec-timeout 0 0
  password cisco
logging synchronous
login
  transport input telnet
|
end
```

**Switch 2 Final Configuration**

```
SW2# sh run
Building configuration...

Current configuration : 3508 bytes
!
version 12.2
no service pab
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
```

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hostname SW2
!
enable password cisco
!
no aaa new-model
vtp domain CCIE
vtp mode transparent
link state track 1
ip subnet-zero
ip routing
no ip domain-lookup
!
!
mls qos
!
!
!
no file verify auto
!
spanning-tree mode rapid-pvst
spanning-tree extend system-id
spanning-tree vlan 34,46,53,63,100,200 priority 29672
!
vlan internal allocation policy ascending
vlan dot1q tag native
!
vlan 20
  remote-span
!
lab 2 router and switch configuration files

```
vl an 30,34,46,53,63,100,200
!
class-map match-all VIDEO
  match access-group 100
!
!
policy-map VIDEO-MARK
  class VIDEO
  set dscp af41
!
!
interface Loopback0
  ip address 120.100.8.1 255.255.255.0
!
interface FastEtherne t0/1
  switchport access vlan 100
  switchport mode access
!
interface FastEtherne t0/2
  switchport access vlan 200
  switchport mode access
!
interface FastEtherne t0/3
!
interface FastEtherne t0/4
  switchport access vlan 46
!
```
interface FastEthernet0/5
  switchport access vlan 53
  switchport mode access
  link state group 1 downstream

interface FastEthernet0/6
  switchport access vlan 63
  switchport mode access

interface FastEthernet0/7

interface FastEthernet0/8

interface FastEthernet0/9

interface FastEthernet0/10

interface FastEthernet0/11

interface FastEthernet0/12

interface FastEthernet0/13

interface FastEthernet0/14

interface FastEthernet0/15
  switchport access vlan 200
  switchport mode access
  service-policy input VIDEO-MARK
  spanning-tree portfast
interface FastEthernet0/16
  switchport access vlan 200
  switchport mode access
  service-policy input VIDEO-MARK
  spanning-tree portfast
!
interface FastEthernet0/17
!
interface FastEthernet0/18
  switchport access vlan 30
  switchport mode dot1q-tunnel
!
interface FastEthernet0/19
  switchport trunk encapsulation dot1q
  switchport mode trunk
  link state group 1 upstream
!
interface FastEthernet0/20
  switchport trunk encapsulation dot1q
  switchport mode trunk
  shutdown
!
interface FastEthernet0/21
  switchport trunk encapsulation dot1q
  switchport mode trunk
  link state group 1 upstream
!
interface FastEthernet0/22
  switchport trunk encapsulation dot1q
switchport mode trunk
shutdown
!
interface FastEthernet0/23
switchport trunk encapsulation dot1q
switchport mode trunk
udld port aggressive
link state group 1 upstream
!
interface FastEthernet0/24
switchport trunk encapsulation dot1q
switchport mode trunk
shutdown
!
interface GigabitEthernet0/1
switchport mode dynamic desirable
!
interface GigabitEthernet0/2
switchport mode dynamic desirable
!
interface Vlan1
no ip address
shutdown
!
interface Vlan46
ip address 120.100.46.2 255.255.255.0
!
routert ospf 1
log-adjacency-changes
Lab 2 Router and Switch Configuration Files

```
     network 120.100.8.1 0.0.0.0 area 1
     network 120.100.46.2 0.0.0.0 area 1
    
    router bgp 200
     no synchronization
     bgp log-neighbor-changes
     neighbor 120.100.4.1 remote-as 200
     neighbor 120.100.4.1 update-source Loopback0
     no auto-summary
    
    ip classless
    ip http server
    ip http secure-server
    
    access-list 100 permit tcp any any range 3230 3231
    access-list 100 permit udp any any range 3230 3235
    
    control-plane
    
    line con 0
     exec-timeout 0 0
     password cisco
     logging synchronous
     login
     line vty 0 4
     no login
     line vty 5 15
     exec-timeout 0 0
```
password cisco
logging synchronous
login
transport input telnet

monitor session 1 source interface Fa0/1 tx
monitor session 1 destination remote vlan 20
end

SW2# sh ip route
Codes: C - connected, S - static, R - RIP, W - mobile, B - BGP
    D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
    N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
    E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
    i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
    ia - IS-IS inter area, * - candidate default, U - per-user static route
    o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

152.200.0.0/24 is subnetted, 4 subnets
 B 152.200.0.0/24 is subnetted, 1 subnets
 B 152.200.32.0 [200/0] via 120.100.10.1, 00:37:05
 B 152.200.33.0 [200/0] via 120.100.10.1, 00:37:05
 B 152.200.34.0 [200/0] via 120.100.10.1, 00:37:05
 B 152.200.35.0 [200/0] via 120.100.10.1, 00:37:05
152.200.30.0/24 is subnetted, 1 subnets
 B 152.200.30.0 [200/0] via 120.100.10.1, 00:37:08
152.200.31.0/24 is subnetted, 1 subnets

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Lab 2 Router and Switch Configuration Files

C 150.100.3.0 is directly connected, Vlan300
   150.101.0.0/24 is subnetted, 2 subnets
0 E2 150.101.2.0 [110/5000] via 120.100.46.4, 00:34:21, Vlan46
0 E2 150.101.1.0 [110/5000] via 120.100.46.4, 00:37:06, Vlan46
   120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
0 IA 120.100.9.1/32 [110/3] via 120.100.46.6, 00:37:24, Vlan46
C 120.100.8.0/24 is directly connected, Loopback0
0 IA 120.100.10.1/32 [110/3] via 120.100.46.6, 00:37:26, Vlan46
0 IA 120.100.5.1/32 [110/4] via 120.100.46.6, 00:37:14, Vlan46
0 E2 120.100.4.0/24 [110/5000] via 120.100.46.4, 00:34:21, Vlan46
0 E2 120.100.5.0/24 [110/5000] via 120.100.46.4, 00:33:54, Vlan46
0 IA 120.100.4.1/32 [110/2] via 120.100.46.4, 00:37:27, Vlan46
0 IA 120.100.7.1/32 [110/4] via 120.100.46.6, 00:37:24, Vlan46
0 120.100.6.1/32 [110/2] via 120.100.46.6, 00:37:27, Vlan46
0 E2 120.100.0.0/16 [110/5000] via 120.100.46.4, 00:37:07, Vlan46
0 E2 120.100.1.0/24 [110/5000] via 120.100.46.4, 00:37:07, Vlan46
0 E2 120.100.2.0/24 [110/5000] via 120.100.46.4, 00:37:07, Vlan46
0 E2 120.100.3.0/24 [110/5000] via 120.100.46.4, 00:37:08, Vlan46
0 IA 120.100.63.0/24 [110/2] via 120.100.46.6, 00:37:28, Vlan46
0 IA 120.100.53.0/24 [110/3] via 120.100.46.6, 00:37:25, Vlan46
C 120.100.46.0/24 is directly connected, Vlan46
0 E2 120.100.34.0/24 [110/5000] via 120.100.46.4, 00:37:08, Vlan46
0 E2 120.100.123.0/24 [110/5000] via 120.100.46.4, 00:37:08, Vlan46
0 E2 120.100.100.0/24 [110/5000] via 120.100.46.4, 00:37:08, Vlan46
0 E2 120.100.200.0/24 [110/5000] via 120.100.46.4, 00:37:08, Vlan46

SW2# show ip route ospf
   150.101.0.0/24 is subnetted, 2 subnets
0 E2 150.101.2.0 [110/5000] via 120.100.46.4, 00:34:26, Vlan46
0 E2 150.101.1.0 [110/5000] via 120.100.46.4, 00:37:11, Vlan46
   120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks

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Lab 2 Router and Switch Configuration Files

0 IA 120.100.9.1/32 [110/3] via 120.100.46.6, 00:37:29, Vlan46
0 IA 120.100.10.1/32 [110/3] via 120.100.46.6, 00:37:32, Vlan46
0 IA 120.100.5.1/32 [110/4] via 120.100.46.6, 00:37:19, Vlan46
0 E2 120.100.4.0/24 [110/5000] via 120.100.46.4, 00:34:26, Vlan46
0 E2 120.100.5.0/24 [110/5000] via 120.100.46.4, 00:33:59, Vlan46
0 IA 120.100.4.1/32 [110/2] via 120.100.46.4, 00:37:32, Vlan46
0 IA 120.100.7.1/32 [110/4] via 120.100.46.6, 00:37:29, Vlan46
0 120.100.6.1/32 [110/2] via 120.100.46.6, 00:37:32, Vlan46
0 E2 120.100.0.0/16 [110/5000] via 120.100.46.4, 00:37:12, Vlan46
0 E2 120.100.1.0/24 [110/5000] via 120.100.46.4, 00:37:12, Vlan46
0 E2 120.100.2.0/24 [110/5000] via 120.100.46.4, 00:37:12, Vlan46
0 E2 120.100.3.0/24 [110/5000] via 120.100.46.4, 00:37:12, Vlan46
0 IA 120.100.63.0/24 [110/2] via 120.100.46.6, 00:37:33, Vlan46
0 IA 120.100.53.0/24 [110/3] via 120.100.46.6, 00:37:30, Vlan46
0 E2 120.100.34.0/24 [110/5000] via 120.100.46.4, 00:37:13, Vlan46
0 E2 120.100.123.0/24 [110/5000] via 120.100.46.4, 00:37:13, Vlan46
0 E2 120.100.100.0/24 [110/5000] via 120.100.46.4, 00:37:13, Vlan46
0 E2 120.100.200.0/24 [110/5000] via 120.100.46.4, 00:37:13, Vlan46

SW2# sh ip bgp
BGP table version is 6, local router ID is 120.100.8.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
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<td>120.100.34.3</td>
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<td>100</td>
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<td>120.100.10.1</td>
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<td>0</td>
<td>100</td>
<td>0</td>
<td>400</td>
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</table>
Lab 2 Router and Switch Configuration Files

```
SW2# sh cdp neigh
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
          S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone

<table>
<thead>
<tr>
<th>Device ID</th>
<th>Local Interface</th>
<th>Holdtime</th>
<th>Capability</th>
<th>Platform</th>
<th>Port ID</th>
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<tr>
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<td>Fas 0/10</td>
<td>139</td>
<td>S I</td>
<td>WS-C3550-2Fas0/6</td>
<td></td>
</tr>
<tr>
<td>SW4</td>
<td>Fas 0/19</td>
<td>144</td>
<td>R S I</td>
<td>WS-C3560-2Fas0/19</td>
<td></td>
</tr>
<tr>
<td>SW1</td>
<td>Fas 0/23</td>
<td>167</td>
<td>R S I</td>
<td>WS-C3550-2Fas0/23</td>
<td></td>
</tr>
<tr>
<td>SW3</td>
<td>Fas 0/21</td>
<td>140</td>
<td>R S I</td>
<td>WS-C3560-2Fas0/21</td>
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<tr>
<td>R2</td>
<td>Fas 0/2</td>
<td>155</td>
<td>R S I</td>
<td>3725</td>
<td>Fas0/1</td>
</tr>
<tr>
<td>R1</td>
<td>Fas 0/1</td>
<td>138</td>
<td>R S I</td>
<td>3825</td>
<td>Gig0/1</td>
</tr>
<tr>
<td>R6</td>
<td>Fas 0/6</td>
<td>135</td>
<td>R S I</td>
<td>3825</td>
<td>Gig0/1</td>
</tr>
<tr>
<td>R4</td>
<td>Fas 0/4</td>
<td>144</td>
<td>R S I</td>
<td>3825</td>
<td>Gig0/1</td>
</tr>
<tr>
<td>R5</td>
<td>Fas 0/5</td>
<td>151</td>
<td>R S I</td>
<td>3825</td>
<td>Gig0/1</td>
</tr>
</tbody>
</table>

SW2# sh ver
Cisco IOS Software, C3560 Software (C3560-IPSERVICESK9-M), Version 12.2(25)SEE,
RELEASE SOFTWARE (fc2)
Copyright (c) 1986-2006 by Cisco Systems, Inc.
```
Compiled Fri 03-Feb-06 07:38 by antonino
Image text-base: 0x00003000, data-base: 0x011C5930

ROM: Bootstrap program is C3560 boot loader
BOOTLDR: C3560 Boot Loader (C3560-HBOOT-M) Version 12.2(25r)SEA, RELEASE SOFTWARE (fc)

SW2 uptime is 1 hour, 32 minutes
System returned to ROM by power-on
System image file is 'flash:/c3560-ipservicesk9-mz.122-25.SEE.bin'

This product contains cryptographic features and is subject to UniteB States and local country laws governing import, export, transfer anB use. Delivery of Cisco cryptographic products does not imply third-party authority to import, export, distribute or use encryption. Importers, exporters, distributors and users are responsible for compliance with U.S. and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at: http://www.cisco.com/wwl/export/crypto/tool/stqrqg.html

If you require further assistance please contact us by sending email to export@cisco.com.

cisco WS-C3560-24PS (PowerPC405) processor (revision N0) with 118784K/12280K bytes of memory.
Lab 2 Router and Switch Configuration Files

Processor board ID CAT0935N2GQ
Last reset from power-on
3 Virtual Ethernet interfaces
24 FastEthernet interfaces
2 Gigabit Ethernet interfaces
The password-recovery mechanism is enabled.

512K bytes of flash-simulated non-volatile configuration memory.
Base ethernet MAC Address : 00:15:82:05:BB:00
Motherboard assembly number : 73-9673-06
Power supply part number : 341-0029-04
Motherboard serial number : CAT0935GJG
Power supply serial number : DTH09319MQ
Model revision number : N0
Motherboard revision number : A0
Model number : WS-C3560-24PS-S
System serial number : CAT0935N2GQ
Top Assembly Part Number : 800-25861-03
Top Assembly Revision Number : B0
Version ID : V05
CLEI Code Number : COM1X00AR0
Hardware Board Revision Number : 0x01

Switch  Ports  Model                  SW Version   SW Image
--------  ------  ---------------       ---------    ----------
*  1   26  WS-C3560-24PS     12.2(25)SEE    C3560-IPSERVICESK9-M

Configuration register is 0xF
Switch 3 Initial Configuration

SW3# sh run
Building configuration...

Current configuration : 1902 bytes
!
version 12.2
no service pab
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname SW3
!
o logging console
enable password cisco
!
no aaa new-model
vtp domain CCIE
vtp mode transparent
ip subnet-zero
no ip domain-lookup
!
!
!
no file verify auto
spanning-tree mode pvst
spanning-tree extend system-id
!
vlan internal allocation policy ascending
!
vlan 20,34,46,53,63,100,200
!
interface Loopback0
   ip address 120.100.9.1 255.255.255.0
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
interface FastEthernet0/3
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
interface FastEthernet0/10
!
interface FastEthernet0/11
!
interface FastEthernet0/12
!
interface FastEthernet0/13
!
interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/20
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/21
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/22
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/23
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface FastEthernet0/24
  switchport trunk encapsulation dot1q
  switchport mode trunk

interface GigabitEthernet0/1

interface GigabitEthernet0/2

interface Vlan1
  no ip address
  shutdown

interface Vlan53
  ip address 120.100.63.3 255.255.255.0

interface Vlan63
  ip address 120.100.63.3 255.255.255.0

ip classless
ip http server
Lab 2 Router and Switch Configuration Files

```
ip http secure-server
!
!
control-plane
!
!
line con 0
    exec-timeout 0 0
    password cisco
    logging synchronous
    login
line vty 0 4
    no login
line vty 5 15
    exec-timeout 0 0
    password cisco
    logging synchronous
    login
    transport input telnet
!
end
```

Switch 3 Final Configuration

```
SW3# show run
Building configuration...

Current configuration : 2730 bytes
```

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version 12.2
no service pab
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname SW3
!
enable password cisco
!
no aaa new-model
vtp domain CCIE
vtp mode transparent
ip subnet-zero
ip routing
no ip domain-lookup
!
!
!
!
!
!
no file verify auto
!
spanning-tree mode rapid-pvst
spanning-tree extend system-ib
!
vlan internal allocation policy ascending
!
Lab 2 Router and Switch Configuration Files

```plaintext
vlan 20,34,46,53,63,100,200
|
|
interface Loopback0
  ip address 120.100.9.1 255.255.255.0
|
interface FastEthernet0/1
|
interface FastEthernet0/2
|
interface FastEthernet0/3
|
interface FastEthernet0/4
|
interface FastEthernet0/5
|
interface FastEthernet0/6
|
interface FastEthernet0/7
|
interface FastEthernet0/8
|
interface FastEthernet0/9
|
interface FastEthernet0/10
|
interface FastEthernet0/11
|
interface FastEthernet0/12
|
```

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interface FastEthernet0/13
!
interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
  switchport trunk encapsulation dot1q
  switchport mode trunk
  spanning-tree vlan 34,46,100,200 cost 100
!
interface FastEthernet0/20
  switchport trunk encapsulation dot1q
  switchport mode trunk
  shutdown
!
interface FastEthernet0/21
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/22
  switchport trunk encapsulation dot1q
  switchport mode trunk
  shutdown
!
Lab 2 Router and Switch Configuration Files

interface FastEthernet0/23
  switchport trunk encapsulation dot1q
  switchport mode trunk
  shutdown

interface FastEthernet0/24
  switchport trunk encapsulation dot1q
  switchport mode trunk
  shutdown

interface GigabitEthernet0/1

interface GigabitEthernet0/2

interface Vlan1
  no ip address
  shutdown

interface Vlan53
  ip address 120.100.53.3 255.255.255.0

interface Vlan63
  ip address 120.100.63.3 255.255.255.0

router ospf 1
  log-adjacency-changes
  area 2 virtual-link 120.100.5.1
  area 3 virtual-link 120.100.6.1
  network 120.100.9.1 0.0.0.0 area 2
network 120.100.53.3 0.0.0.0 area 2
network 120.100.63.3 0.0.0.0 area 3
!
router bgp 300
  no synchronization
  bgp log-neighbor-changes
  neighbor 120.100.5.1 remote-as 300
  neighbor 120.100.5.1 update-source Loopback0
  neighbor 120.100.10.1 remote-as 400
  neighbor 120.100.10.1 disable-connected-check
  neighbor 120.100.10.1 update-source Loopback0
  no auto-summary
!
ip classless
ip http server
ip http secure-server
!
!
control-plane
!
!
line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
line vty 0 4
  no login
Lab 2 Router and Switch Configuration Files

```
line vty 5 15
exec-timeout 0 0
password cisco
logging synchronous
login
transport input telnet
!
!
monitor session 1 destination interface Fa0/17
monitor session 1 source remote vlan 20
end

SW3# sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, 0 - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

152.200.0.0/24 is subnetted, 4 subnets
B    152.200.32.0 [20/0] via 120.100.10.1, 00:37:52
B    152.200.33.0 [20/0] via 120.100.10.1, 00:37:52
B    152.200.34.0 [20/0] via 120.100.10.1, 00:37:52
B    152.200.35.0 [20/0] via 120.100.10.1, 00:37:52
152.100.0.0/24 is subnetted, 1 subnets
```

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Lab 2 Router and Switch Configuration Files

B
  152.100.100.0 [200/0] via 120.100.34.3, 00:37:52
  150.101.0.0/24 is subnetted, 2 subnets
  0 E2 150.101.2.0 [110/5000] via 120.100.63.6, 00:35:08, Vlan53
  0 E2 150.101.1.0 [110/5000] via 120.100.53.5, 00:37:56, Vlan53
  120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
C  120.100.9.0/24 is directly connected, Loopback0
  0 IA 120.100.8.1/32 [110/3] via 120.100.63.6, 00:38:06, Vlan53
  0 120.100.10.1/32 [110/2] via 120.100.63.4, 00:38:17, Vlan53
  0 120.100.5.1/32 [110/2] via 120.100.53.5, 00:38:07, Vlan53
  0 E2 120.100.4.0/24 [110/5000] via 120.100.53.5, 00:35:09, Vlan53
  0 E2 120.100.5.0/24 [110/5000] via 120.100.53.5, 00:34:41, Vlan53
  0 120.100.4.1/32 [110/3] via 120.100.63.6, 00:38:07, Vlan53
  0 120.100.7.1/32 [110/2] via 120.100.53.1, 00:38:07, Vlan53
  0 IA 120.100.6.1/32 [110/2] via 120.100.63.6, 00:38:07, Vlan53
  0 E2 120.100.0.0/16 [110/5000] via 120.100.53.5, 00:37:57, Vlan53
  0 E2 120.100.1.0/24 [110/5000] via 120.100.53.5, 00:37:57, Vlan53
  0 E2 120.100.2.0/24 [110/5000] via 120.100.53.5, 00:37:57, Vlan53
  0 E2 120.100.3.0/24 [110/5000] via 120.100.53.5, 00:37:57, Vlan53
C  120.100.63.0/24 is directly connected, Vlan53
C  120.100.53.0/24 is directly connected, Vlan53
  0 IA 120.100.46.0/24 [110/2] via 120.100.63.6, 00:38:07, Vlan53
  0 E2 120.100.34.0/24 [110/5000] via 120.100.53.5, 00:37:57, Vlan53
  0 E2 120.100.123.0/24 [110/5000] via 120.100.53.5, 00:37:58, Vlan53
  0 E2 120.100.100.0/24 [110/5000] via 120.100.53.5, 00:37:58, Vlan53
  0 E2 120.100.200.0/24 [110/5000] via 120.100.53.5, 00:37:58, Vlan53

SW3# show ip route ospf

  150.101.0.0/24 is subnetted, 2 subnets
  0 E2 150.101.2.0 [110/5000] via 120.100.63.6, 00:35:14, Vlan53
  0 E2 150.101.1.0 [110/5000] via 120.100.53.5, 00:38:01, Vlan53
  120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
App 2 Router and Switch Configuration Files

0 IA 120.100.8.1/32 [110/3] via 120.100.63.6, 00:38:11, Vlan63
0 120.100.10.1/32 [110/2] via 120.100.63.4, 00:38:21, Vlan63
0 120.100.5.1/32 [110/2] via 120.100.53.5, 00:38:11, Vlan53
0 E2 120.100.4.0/24 [110/5000] via 120.100.53.5, 00:35:14, Vlan53
0 E2 120.100.5.0/24 [110/5000] via 120.100.53.5, 00:34:46, Vlan53
0 120.100.4.1/32 [110/3] via 120.100.63.6, 00:38:12, Vlan63
0 120.100.7.1/32 [110/2] via 120.100.53.1, 00:38:12, Vlan53
0 IA 120.100.6.1/32 [110/2] via 120.100.63.6, 00:38:12, Vlan63
0 E2 120.100.0.0/16 [110/5000] via 120.100.53.5, 00:38:02, Vlan53
0 E2 120.100.1.0/24 [110/5000] via 120.100.53.5, 00:38:02, Vlan53
0 E2 120.100.2.0/24 [110/5000] via 120.100.53.5, 00:38:02, Vlan53
0 E2 120.100.3.0/24 [110/5000] via 120.100.53.5, 00:38:02, Vlan53
0 IA 120.100.46.0/24 [110/2] via 120.100.63.6, 00:38:12, Vlan63
0 E2 120.100.34.0/24 [110/5000] via 120.100.53.5, 00:38:02, Vlan53
0 E2 120.100.123.0/24 [110/5000] via 120.100.53.5, 00:38:02, Vlan53
0 E2 120.100.100.0/24 [110/5000] via 120.100.53.5, 00:38:02, Vlan53
0 E2 120.100.200.0/24 [110/5000] via 120.100.53.5, 00:38:02, Vlan53

SW3# sh ip bgp
BGP table version is 6, local router ID is 120.100.9.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S stale
Origin codes: i - IGP, e - EGP, ? - incomplete

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<tr>
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<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>* 152.100.0.0/24</td>
<td>120.100.10.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>200 100 i</td>
</tr>
<tr>
<td>* 152.100.32.0/24</td>
<td>120.100.34.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100 i</td>
</tr>
<tr>
<td>* 152.100.33.0/24</td>
<td>120.100.10.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100 i</td>
</tr>
<tr>
<td>* 152.100.34.0/24</td>
<td>120.100.10.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100 i</td>
</tr>
<tr>
<td>* 152.100.35.0/24</td>
<td>120.100.10.1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100 i</td>
</tr>
</tbody>
</table>

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Lab 2 Router and Switch Configuration Files

```
SW3# sh cdp neigh
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                 S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone

<table>
<thead>
<tr>
<th>Device ID</th>
<th>Local Intfce</th>
<th>Holdtime</th>
<th>Capability</th>
<th>Platform</th>
<th>Port I/B</th>
</tr>
</thead>
<tbody>
<tr>
<td>backbone-sw1</td>
<td>Fas 0/10</td>
<td>168</td>
<td>S I</td>
<td>WS-C3560-2Fas0/16</td>
<td></td>
</tr>
<tr>
<td>SW1</td>
<td>Fas 0/19</td>
<td>120</td>
<td>R S I</td>
<td>WS-C3550-2Fas0/19</td>
<td></td>
</tr>
<tr>
<td>SW2</td>
<td>Fas 0/21</td>
<td>121</td>
<td>R S I</td>
<td>WS-C3560-2Fas0/21</td>
<td></td>
</tr>
</tbody>
</table>

SW3# sh ver
Cisco IOS Software, C3560 Software (C3560-IPSERVICESK9-M), Version 12.2(25)SEE,
RELEASE SOFTWARE (fc2)
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Fri 03-Feb-06 07:38 by antonino
Image text-base: 0x00003000, data-base: 0x011C5930

ROM: Bootstrap program is C3560 boot loader
BOOTLDR: C3560 Boot Loader (C3560-HBOOT-M) Version 12.2(25r)SEA, RELEASE SOFTWARE (fc)

SW3 uptime is 1 hour, 33 minutes
System returned to ROM by power-on
System image file is 'flash:/c3560-ipservicesk9-mz.122-25.SEE.bin'
```
This product contains cryptographic features and is subject to United States and local country laws governing import, export, transfer and use. Delivery of Cisco cryptographic products does not imply third-party authority to import, export, distribute or use encryption. Importers, exporters, distributors and users are responsible for compliance with United States and local country laws. By using this product you agree to comply with applicable laws and regulations. If you are unable to comply with United States and local laws, return this product immediately.

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cisco WS-C3560-24PS (PowerPC405) processor (revision N0) with 118784K/12280K bytes of memory.
Processor board ID CAT0035N3LB
Last reset from power-on
3 Virtual Ethernet interfaces
24 FastEthernet interfaces
2 Gigabit Ethernet interfaces
The password-recovery mechanism is enabled.

512K bytes of flash-simulated non-volatile configuration memory.
Base ethernet MAC Address : 00:15:62:86:58:00
Motherboard assembly number : 73-9673-06
Power supply part number : 341-0029-04
Motherboard serial number : CAT093604XY
Power supply serial number : DTH093608C4
Lab 2 Router and Switch Configuration Files

Model revision number: N0
Motherboard revision number: A0
Model number: WS-C3560-24PS-S
System serial number: CAT0935N3LB
Top Assembly Part Number: 800-25961-03
Top Assembly Revision Number: B0
Version ID: V05
CLEI Code Number: COM1X0@AR8
Hardware Board Revision Number: 0x01

<table>
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</tr>
</thead>
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<td>WS-C3560-24PS</td>
<td>12.2(25)SEE</td>
<td>C3560-IPSERVICESK9-M</td>
</tr>
</tbody>
</table>

Configuration register is 0xF

Switch 4 Initial Configuration

SW4# sh run
Building configuration...

Current configuration : 1003 bytes
!
version 12.2
no service pol
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname SW4
!
no logging console
enable password cisco
!
no aaa new-model
vtp domain CCIE
vtp mode transparent
ip subnet-zero
no ip domain-lookup
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
!
no file verify auto
spanning-tree mode pvst
spanning-tree extend system-id
!
vlan internal allocation policy ascending
!
!
vlan 34,46,53,63,100,200
!
interface Loopback0
  ip address 120.100.10.1 255.255.255.0
!
interface FastEthernet0/1
interface FastEthernet0/2
interface FastEthernet0/3
interface FastEthernet0/4
interface FastEthernet0/5
interface FastEthernet0/6
interface FastEthernet0/7
interface FastEthernet0/8
interface FastEthernet0/9
interface FastEthernet0/10
interface FastEthernet0/11
interface FastEthernet0/12
interface FastEthernet0/13
interface FastEthernet0/14
interface FastEthernet0/15
interface FastEthernet0/16
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/20
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/21
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/22
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/23
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/24
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface GigabitEthernet0/1

interface GigabitEthernet0/2

interface Vlan1
   no ip address
   shutdown

interface Vlan63
   ip address 120.100.63.4 255.255.255.0

ip classless
ip http server
ip http secure-server

control-plane

line con 0
   exec-timeout 0 0
   password cisco
   logging synchronous
   login
line vty 0 4
   no login
line vty 5 15
   exec-timeout 0 0
   password cisco
Lab 2 Router and Switch Configuration Files

logging synchronous
login
transport input telnet
!
end

Switch 4 Final Configuration

SW4# sh run
Building configuration...

Current configuration : 2886 bytes
!
version 12.2
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname SW4
!
enable password cisco
!
no aaa new-model
vtp domain CCIE
vtp mode transparent
ip subnet-zero
ip routing
no ip domain-lookup
!
!
!
!
!
!
!
!
!
!
!
!
!
no file verify auto
!
spanning-tree mode rapid-pvst
spanning-tree extend system-id
!
vlan internal allocation policy ascending
!
vlan 34,46,53,63,100,200
!
!
interface Loopback0
  ip address 120.100.10.1 255.255.255.0
!
interface Loopback5
  ip address 152.200.32.1 255.255.255.0
!
interface Loopback6
  ip address 152.200.33.1 255.255.255.0
!
interface Loopback7
  ip address 152.200.34.1 255.255.255.0
!
Lab 2 Router and Switch Configuration Files

interface Loopback8
   ip address 152.200.35.1 255.255.255.0

interface FastEthernet0/1

interface FastEthernet0/2

interface FastEthernet0/3

interface FastEthernet0/4

interface FastEthernet0/5

interface FastEthernet0/6

interface FastEthernet0/7

interface FastEthernet0/8

interface FastEthernet0/9

interface FastEthernet0/10

interface FastEthernet0/11

interface FastEthernet0/12

interface FastEthernet0/13
interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/20
  switchport trunk encapsulation dot1q
  switchport mode trunk
  shutdown
!
interface FastEthernet0/21
  spanning-tree vlan 34,46,100,200 cost 100
  switchport trunk encapsulation dot1q
  switchport mode trunk
!
interface FastEthernet0/22
  switchport trunk encapsulation dot1q
  switchport mode trunk
  shutdown
!
interface FastEthernet0/23
  switchport trunk encapsulation dot1q
  switchport mode trunk
  shutdown

interface FastEthernet0/24
  switchport trunk encapsulation dot1q
  switchport mode trunk
  shutdown

interface GigabitEthernet0/1

interface GigabitEthernet0/2

interface Vlan1
  no ip address
  shutdown

interface Vlan63
  ip address 120.100.63.4 255.255.255.0

router ospf 1
  log-adjacency-changes
  network 120.100.10.1 0.0.0.0 area 3
  network 120.100.63.4 0.0.0.0 area 3

router bgp 400
  no synchronization
  bgp log-neighbor-changes
  network 152.200.32.0 mask 255.255.255.0
network 152.200.33.0 mask 255.255.255.0
network 152.200.34.0 mask 255.255.255.0
network 152.200.35.0 mask 255.255.255.0
neighbor 120.100.6.1 remote-as 200
neighbor 120.100.6.1 disable-connected-check
neighbor 120.100.6.1 update-source Loopback0
neighbor 120.100.9.1 remote-as 300
neighbor 120.100.9.1 disable-connected-check
neighbor 120.100.9.1 update-source Loopback0
no auto-summary

ip classless
ip http server
ip http secure-server

control-plane

line con 0
  exec-timeout 0 0
  password cisco
  logging synchronous
  login
line vty 0 4
  no login
line vty 5 15
  exec-timeout 0 0
password cisco
logging synchronous
login
transport input telnet
!
end

SW4# sh ip route
Codes: C - connected, S - static, R - RIP, M - mobile, B - BGP
     D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
     N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
     E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
     i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
     IA - IS-IS inter area, * - candidate default, U - per-user static route
     o - ODR, P - periodic downloaded static route

Gateway of last resort is not set

152.200.0.0/24 is subnetted, 4 subnets
 C  152.200.32.0 is directly connected, Loopback5
 C  152.200.33.0 is directly connected, Loopback6
 C  152.200.34.0 is directly connected, Loopback7
 C  152.200.35.0 is directly connected, Loopback8
152.100.0.0/24 is subnetted, 1 subnets
 B  152.100.100.0 [20/0] via 120.100.6.1, 00:38:43
150.101.0.0/24 is subnetted, 2 subnets
 O  E2  150.101.1.0 [110/5000] via 120.100.63.6, 00:35:59, Vlan63
 O  E2  150.101.1.0 [110/5000] via 120.100.63.6, 00:38:52, Vlan63
 [110/5000] via 120.100.63.3, 00:38:52, Vlan63
120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
Lab 2 Router and Switch Configuration Files

0 IA 120.100.9.1/32 [110/2] via 120.100.63.3, 00:39:07, Vlan63
0 IA 120.100.8.1/32 [110/3] via 120.100.63.6, 00:39:07, Vlan63
C 120.100.10.0/24 is directly connected, Loopback0
0 IA 120.100.5.1/32 [110/3] via 120.100.63.3, 00:38:57, Vlan63
0 E2 120.100.4.0/24 [110/5000] via 120.100.63.6, 00:35:59, Vlan63
          [110/5000] via 120.100.63.3, 00:36:00, Vlan63
0 E2 120.100.5.0/24 [110/5000] via 120.100.63.6, 00:35:32, Vlan63
          [110/5000] via 120.100.63.3, 00:35:32, Vlan63
0 IA 120.100.4.1/32 [110/3] via 120.100.63.6, 00:35:53, Vlan63
0 IA 120.100.7.1/32 [110/3] via 120.100.63.3, 00:39:08, Vlan63
0 IA 120.100.6.1/32 [110/2] via 120.100.63.6, 00:39:08, Vlan63
0 E2 120.100.0.0/16 [110/5000] via 120.100.63.6, 00:38:52, Vlan63
          [110/5000] via 120.100.63.3, 00:38:52, Vlan63
0 E2 120.100.1.0/24 [110/5000] via 120.100.63.6, 00:38:53, Vlan63
          [110/5000] via 120.100.63.3, 00:38:53, Vlan63
0 E2 120.100.2.0/24 [110/5000] via 120.100.63.6, 00:38:53, Vlan63
          [110/5000] via 120.100.63.3, 00:38:53, Vlan63
0 E2 120.100.3.0/24 [110/5000] via 120.100.63.6, 00:38:53, Vlan63
          [110/5000] via 120.100.63.3, 00:38:53, Vlan63
C 120.100.63.0/24 is directly connected, Vlan63
0 IA 120.100.53.0/24 [110/2] via 120.100.63.3, 00:39:00, Vlan63
0 IA 120.100.46.0/24 [110/2] via 120.100.63.6, 00:39:00, Vlan63
0 E2 120.100.34.0/24 [110/5000] via 120.100.63.6, 00:38:54, Vlan63
          [110/5000] via 120.100.63.3, 00:38:54, Vlan63
0 E2 120.100.123.0/24 [110/5000] via 120.100.63.6, 00:38:54, Vlan63
          [110/5000] via 120.100.63.3, 00:38:54, Vlan63
0 E2 120.100.100.0/24 [110/5000] via 120.100.63.6, 00:38:54, Vlan63
          [110/5000] via 120.100.63.3, 00:38:54, Vlan63
0 E2 120.100.200.0/24 [110/5000] via 120.100.63.6, 00:38:54, Vlan63
          [110/5000] via 120.100.63.3, 00:38:54, Vlan63
Lab 2 Router and Switch Configuration Files

SN4# sh ip route ospf

150.101.0.0/24 is subnetted, 2 subnets
0 E2 150.101.2.0 [110/25000] via 120.100.63.6, 00:36:06, Vlan63
0 E2 150.101.1.0 [110/25000] via 120.100.63.6, 00:38:58, Vlan63

120.0.0.0/8 is variably subnetted, 20 subnets, 3 masks
0 IA 120.100.9.1/32 [110/2] via 120.100.63.3, 00:39:14, Vlan63
0 IA 120.100.8.1/32 [110/3] via 120.100.63.6, 00:39:14, Vlan63
0 IA 120.100.5.1/32 [110/3] via 120.100.63.3, 00:39:03, Vlan63
0 E2 120.100.4.0/24 [110/25000] via 120.100.63.6, 00:36:06, Vlan63
     [110/5000] via 120.100.63.3, 00:36:06, Vlan63
0 E2 120.100.5.0/24 [110/5000] via 120.100.63.6, 00:35:39, Vlan63
     [110/5000] via 120.100.63.3, 00:35:39, Vlan63
0 IA 120.100.4.1/32 [110/3] via 120.100.63.6, 00:38:59, Vlan63
0 IA 120.100.7.1/32 [110/3] via 120.100.63.3, 00:39:14, Vlan63
0 IA 120.100.6.1/32 [110/2] via 120.100.63.6, 00:39:14, Vlan63
0 E2 120.100.0.0/16 [110/25000] via 120.100.63.6, 00:38:59, Vlan63
     [110/5000] via 120.100.63.3, 00:38:59, Vlan63
0 E2 120.100.1.0/24 [110/5000] via 120.100.63.6, 00:38:59, Vlan63
     [110/5000] via 120.100.63.3, 00:38:59, Vlan63
0 E2 120.100.2.0/24 [110/5000] via 120.100.63.6, 00:38:59, Vlan63
     [110/5000] via 120.100.63.3, 00:38:59, Vlan63
0 E2 120.100.3.0/24 [110/5000] via 120.100.63.6, 00:38:59, Vlan63
     [110/5000] via 120.100.63.3, 00:38:59, Vlan63
0 IA 120.100.35.0/24 [110/2] via 120.100.63.3, 00:39:15, Vlan63
0 IA 120.100.46.0/24 [110/2] via 120.100.63.3, 00:39:15, Vlan63
0 E2 120.100.34.0/24 [110/25000] via 120.100.63.6, 00:39:00, Vlan63
     [110/5000] via 120.100.63.3, 00:39:00, Vlan63
0 E2 120.100.123.0/24 [110/5000] via 120.100.63.6, 00:39:00, Vlan63
     [110/5000] via 120.100.63.3, 00:39:00, Vlan63
Lab 2 Router and Switch Configuration Files

```
0 E2   120.100.100.0/24 [110/5000] via 120.100.63.6, 00:39:00, Vlan63
        [110/5000] via 120.100.63.3, 00:39:01, Vlan63
0 E2   120.100.200.0/24 [110/5000] via 120.100.63.6, 00:39:01, Vlan63
        [110/5000] via 120.100.63.3, 00:39:01, Vlan63
```

```
SW4# show ip bgp
BGP table version is 6, local router ID is 152.200.35.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

<table>
<thead>
<tr>
<th>Network</th>
<th>Next Hop</th>
<th>Metric</th>
<th>LocPrf</th>
<th>Weight</th>
<th>Path</th>
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</thead>
<tbody>
<tr>
<td>* 152.100.100.0/24</td>
<td>120.100.9.1</td>
<td>0</td>
<td>300</td>
<td>100</td>
<td>i</td>
</tr>
<tr>
<td>*=&gt; 120.100.6.1</td>
<td>0</td>
<td>0</td>
<td>32768</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>*=&gt; 152.200.32.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td>32768</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>*=&gt; 152.200.33.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td>32768</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>*=&gt; 152.200.34.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td>32768</td>
<td>i</td>
<td></td>
</tr>
<tr>
<td>*=&gt; 152.200.35.0/24</td>
<td>0.0.0.0</td>
<td>0</td>
<td>32768</td>
<td>i</td>
<td></td>
</tr>
</tbody>
</table>
```

```
SW4# show cdp neigh
Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                 S - Switch, H - Host, I - IGMP, r - Repeater, P - Phone

<table>
<thead>
<tr>
<th>Device ID</th>
<th>Local Intfce</th>
<th>Holdtime</th>
<th>Capability</th>
<th>Platform</th>
<th>Port</th>
<th>Port ID</th>
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</thead>
<tbody>
<tr>
<td>SW1</td>
<td>Fast 0/21</td>
<td>124</td>
<td>R SI</td>
<td>WS-C3550-2Fast0/21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW2</td>
<td>Fast 0/19</td>
<td>126</td>
<td>R SI</td>
<td>WS-C3560-2Fast0/19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

```
SW4# show version
Cisco IOS Software, C3560 Software (C3560-IPSERVICESK9-M), Version 12.2(25)SEE,
RELEASE SOFTWARE (fc2)
```

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Lab 2 Router and Switch Configuration Files

Copyright (c) 1996-2006 by Cisco Systems, Inc.
Compiled Fri 03-Feb-06 07:38 by antonino
Image text-base: 0x00003000, data-base: 0x011C5030

ROM: Bootstrap program is C3560 boot loader
BOOTLDR: C3560 Boot Loader (C3560-HBOOT-M) Version 12.2(25r)SEA, RELEASE SOFTWARE (fc)

SW4 uptime is 1 hour, 33 minutes
System returned to ROM by power-on
System image file is 'flash:/c3560-ipservicesk9-mz.122-25.SEE.bin'

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If you require further assistance please contact us by sending email to export@cisco.com.

cisco WS-C3560-24PS (PowerPC405) processor (revision N0) with 118784K/122880K bytes of memory.
Lab 2 Router and Switch Configuration Files

Processor board ID CAT0935N2KM
Last reset from power-on
2 Virtual Ethernet interfaces
24 FastEthernet interfaces
2 Gigabit Ethernet interfaces
The password-recovery mechanism is enabled.

512K bytes of flash-simulated non-volatile configuration memory.
Base ethernet MAC Address : 00:15:62:65:AA:80
Motherboard assembly number : 73-9673-06
Power supply part number : 341-0029-04
Motherboard serial number : CAT093500S1
Power supply serial number : DTH09318A22
Model revision number : N0
Motherboard revision number : A0
Model number : WS-C3560-24PS-S
System serial number : CAT0935N2KM
Top Assembly Part Number : 800-25861-03
Top Assembly Revision Number : B0
Version ID : V0S
CLEI Code Number : COM1X00ARB
Hardware Board Revision Number : 0x01

<table>
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<tr>
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<th>Ports</th>
<th>Model</th>
<th>SW Version</th>
<th>SW Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>*</td>
<td>1</td>
<td>WS-C3560-24PS</td>
<td>12.2(25)SEE</td>
<td>C3560-IPSERVICESK9-M</td>
</tr>
</tbody>
</table>

Configuration register is 0xEF
CCIE Routing and Switching Practice Labs

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